PALGRAVE HANDBOOKS

THE PALGRAVE HANDBOOK OF SUSTAINABILITY

Case Studies and Practical Solutions

Edited by Robert Brinkmann
and Sandra J. Garren

The Palgrave Handbook of Sustainability

Robert Brinkmann • Sandra J. Garren
Editors

The Palgrave Handbook of Sustainability

Case Studies and Practical Solutions

palgrave
macmillan

Editors
Robert Brinkmann
Hofstra University
Hempstead, NY, USA

Sandra J. Garren
Hofstra University
Hempstead, NY, USA

ISBN 978-3-319-71388-5 ISBN 978-3-319-71389-2 (eBook)
https://doi.org/10.1007/978-3-319-71389-2

Library of Congress Control Number: 2018936352

Cover illustration: Yuri_Arcurs/gettyimages

Printed on acid-free paper

This Palgrave Macmillan imprint is published by the registered company Springer International Publishing AG part of Springer Nature.
The registered company address is: Gewerbestrasse 11, 6330 Cham, Switzerland

This book is dedicated to everyone who tries to make the world a better place through sustainability efforts in their home, their community, their nation, and the world.

Preface

The idea for this book emerged from conversations we had years ago when we saw that there was a need for greater information about practical and real-world examples of sustainability efforts from around the world. We were inspired by people like Wangari Maathai who worked hard in her own community yet stirred the world to think about local and global sustainability connections. It was our goal to showcase how people around the world were finding ways to come to terms with their sustainability challenges to not only inspire us but to teach us. We believe we have accomplished this goal. We hope the book will be of interest to anyone who wants to learn about ways that sustainability is addressed throughout the world.

The book was also inspired by our students. We have been teaching in the environmental field for many years, and we have found that students are motivated to get engaged in the field of sustainability if they can learn about real-world situations. As a result, each chapter of this book not only has significant background about a particular sustainability topic, it also has a case study to provide context for the issue at hand.

While defining sustainability can be problematic, we took a traditional approach in framing sustainability within the venerable three E's of the field: environment, equity, and economy. The first three parts of the book are roughly divided into these three areas. But we also attempted to obtain distinct regional examples of sustainability initiatives from around the world that can be framed more holistically. These examples make up the final part of the book. We tried to be comprehensive in scope throughout all four parts. However, any attempt to be comprehensive in a book like this will be flawed at the end. It is just impossible to capture all areas of sustainability in a time like this. The field and the world is just too vast. Please forgive any omissions

in content. Because sustainability is a holistic field, many chapters cover themes that might fit in other sections of the book. We know our readers are sophisticated consumers of sustainability information and will understand the challenges inherent in trying to divide sustainability content into comprehensive sections.

Our work on the book, and the work of many of the authors, was informed by the tumultuous times in which we live. We started working with contributing authors on their pieces in 2016 around the time of the Brexit vote and the subsequent elections that resulted in the US presidency of Donald Trump. As we write this preface in late 2017, throughout the world, there is great concern about the future of sustainability initiatives and even greater concern about the future of our planet in general, given the saber rattling of nuclear powers. While some people live in places where sustainability is about technological innovation, many others live in places where sustainability is about trying to find clean water and safety. We believe that the examples in this book are extremely important at this unique moment of time in our collective history. They not only give us a way forward, but they also give us faith that we can work together to solve significant problems.

Putting together such a big book came with some challenges. We worked with dozens of authors from around the world. We are so grateful for their contributions. Their efforts to make the world a better place motivated us. We are lucky to have so many outstanding authors as contributors. Unfortunately, some of the authors had health, family, or professional challenges and had to drop out of the project. While we regret not being able to publish their work, it was wonderful to get to know them. We were truly humbled by the work of so many people in very different settings.

Perhaps one of the biggest challenges we had in developing this book was how to make this work speak to a global audience. Each case study is on a different topic and in a different setting. How do these pieces work together? As the chapters came in, we found that while sustainability infused all the writing, what really brought the work together is the process and the people. All over the world, individuals and communities are joining to work on important issues that have real implications for the survivability of the planet and the quality of life for future generations. The people involved with the case studies in the chapters represent just a small number trying to make the world a better place. The chapters not only inform us how to do sustainability, they also give us hope.

New York, NY, USA

Robert Brinkmann
Sandra J. Garren

Acknowledgments

We would like to thank the authors of the individual chapters who contributed to this volume. In addition, the support of our family and friends is deeply appreciated—especially Mario Gomez and Rachel Kling. We would also like to thank our students who helped with many aspects of this book: Keshanti Nandlall, Lauren D'Orsa, and Mathew Huxel. Finally, we are grateful to the terrific editorial team at Palgrave. Rachael Ballard has been a constant support as we developed this book.

Editors and Contributors

Editors

Robert Brinkmann is the Vice Provost for Scholarship and Research and Dean for Graduate Studies at Hofstra University which is located on Long Island in New York. He is also a Professor of Geology, Environment, and Sustainability. He has a Ph.D. in Geography and a Master's degree and Bachelor's degree in Geology. He has served on the writing team of the Long Island Regional Economic Development Council. His research focuses largely on human alteration of the planet. Specifically, he is interested in soil and water pollution and alteration of karst terrain. He has published dozens of books and articles on sustainability topics. Most recently, he is the author of *Introduction to Sustainability*, one of the first major sustainability textbooks published. He is also the co-editor of this book and the book series editor for environmental sustainability with Palgrave. His writing has been featured on *CNN*, *Newsday*, *Huffington Post*, and his blog, *On the Brink*. He has appeared on a number of television (*CNN*, *CBS News*) and radio stations to talk about sustainability issues. Brinkmann was recently awarded the Eddie Mitchell Memorial Award for his work on human rights in Florida.

Sandra J. Garren, Ph.D. is the Director of Sustainability Research at the National Center for Suburban Studies at Hofstra University. She is also the Director of Sustainability Studies and an Assistant Professor in the Department of Geology, Environment, and Sustainability at Hofstra University. She completed her doctorate in Geography and Environmental Science and Policy Program in the Department of Geosciences at the University of South Florida,

Tampa, in May 2014. She holds a Bachelor's degree in Earth Science/Geology and a Master's degree in Teaching. In total, Sandra has more than 25 years of experience in both academic and environmental sustainability fields which includes principal investigator, project management, and technical expertise for scientific investigations related to sustainability, greenhouse gas accounting, climate change policy, water management, energy, and environmental regulation. Her research is focused on sustainability, water management, and climate policy issues both globally and nationally (including federal, state, and local governments) and is interdisciplinary and specifically focused on applied science and policy that solve problems and find solutions to the negative impacts of climate change and other environmental challenges. She currently teaches courses in sustainable development, sustainability theory, sustainable energy, and geospatial applications in sustainability.

Contributors

Kristin Aunan is Senior Research Fellow at Center for International Climate and Environmental Research in Oslo (CICERO). Her research focuses on exposure to and health effects of air pollution in ambient and indoor environments in China.

Christopher Schreier-Barreto is an architect for the Ricardo Palma University and photographer by the Peruvian Institute of Art and Design. He is a candidate for a Master of Science degree with a major in Architecture: History, Theory, and Critique by the National University of Engineering. He is a full-time Assistant Professor of the Architecture and Project Development Degree at the University of Lima's Office of Academic Projects. He has conducted research on environmental topics for the Institute of Scientific Research of the same university since 2015. He has also participated in various academic publications and professional diffusion with articles on theory and analysis of work, as well as photographs of architecture.

Michelle R. Oswald Beiler is an Associate Professor of Civil and Environmental Engineering at Bucknell University in Lewisburg, PA. Her primary research focus is on sustainable transportation engineering with an emphasis on sustainable performance metrics, pedestrian and cycling mobility, and climate change adaptation planning. She is a Leadership in Energy and Environmental Design Accredited Professional (LEED AP), a Professional Engineer (PE) in the state of Pennsylvania, and a Professional Transportation Planner (PTP).

Morgan C. Benton is a Co-founder of the Burning Man Project and Associate Professor of Integrated Science and Technology (ISAT) at James Madison University (JMU). He holds a Ph.D. and M.S. in Information Systems from the New Jersey Institute of Technology. His research addresses innovation in learning and higher education, focusing on innovative policies, procedures, and environments for producing new knowledge.

Shrimoyee Bhattacharya is a Senior Research Scientist at the Center for Study of Science, Technology and Policy (CSTEP), Bangalore. She has more than a decade of experience as both practitioner and a researcher in the field of urban and regional planning, policy advisory and research, and capacity building of urban institutions. She holds a Master's degree in Urban and Rural Planning from Indian Institute of Technology (IIT), Roorkee. Her research interests include various aspects of sustainable urban development. The author is grateful to Sujaya Rathi, Dr. Sujatha Byravan, Merlin Francis, and Dr. Jai Asundi for reviewing this chapter and to Noelene Marisa Yesudas and Sonali Anusree Patro for their unconditional support through data, graphics, and making this chapter complete by all means.

Stuart Bretschneider is a Foundation Professor of Organization Design and Public Administration at ASU's School of Public Affairs and CORD's Director of Research. His research focuses on innovation in public organizations, the use of information technology and the effects of those technologies on public organizations, and the evaluation of environmental and energy policies.

Komal Brown is a Study Coordinator at Louisiana State University, School of Public Health, USA. She oversees the Lead Exposure Assessment Drinking Water Study, in New Orleans, Louisiana, and regularly collaborates with Lead Safe Louisiana on lead poisoning prevention efforts throughout New Orleans. She works at the forefront of lead issues in New Orleans, focusing her efforts on community engagement, education, and intervention and evaluating the efficacy of potential policy solutions.

Constance Carr, Ph.D. is a Senior Researcher at the Institute of Geography and Spatial Planning of the University of Luxembourg, Luxembourg. She obtained her doctorate from the Humboldt University in Berlin and, before that, her Master's from the Faculty of Environmental Studies of York University, in Toronto. She has published in various journals including *Local Environment*, *Regional Studies*, *Planning Theory & Practice*, *Raumforschung Und Raumordnung*, *European Planning Studies*, and *International Journal of Urban and Regional Research*. Updates on her research can be found at sustain-gov.blogspot.com.

Jenni Cauvain, Ph.D. is a Research Fellow at the School of Sociology and Social Policy at the University of Nottingham, UK. Her field of research is social sustainability in cities. Her research interests include urban justice and citizenship, low-carbon interventions, energy vulnerability, and housing.

Innocent Chirisa, DPhil, MSc, BSc Hons. has completed Rural and Urban Planning, (University of Zimbabwe), DipLMISR (IHS, Erasmus University), MZIRUP (Zimbabwe), Full Professor teaching Urban and Environmental Planning courses in the Department of Rural and Urban Planning, University of Zimbabwe. Currently he is serving as the Deputy Dean of the Faculty of Social Studies, University of Zimbabwe. Also, he is currently serving as the Acting Chairman of the Department of Rural and Urban Planning, University of Zimbabwe. Professor Chirisa was recently appointed as a Research Fellow, Department of Urban and Regional Planning, University of Free State, Bloemfontein, South Africa, for the period 2016–2020.

Tim Cooper is a Professor of Sustainable Design and Consumption at Nottingham Trent University (NTU), UK. His research interests are multidisciplinary, embracing design, consumer behavior, public policy, and environmental ethics. He has a specialist expertise in product longevity and is contributing editor of *Longer Lasting Products* (2010). Tim has managed and contributed to a wide range of research projects, funded by the European Commission, Council of Europe, EPSRC, ESRC, Defra, WRAP, and industry and third-sector organizations. He has acted as research evaluator for the Research Council of Norway, Irish Environmental Protection Agency, and Belgium Federal Science Policy. He is currently Head of the Sustainable Consumption and Clothing Sustainability Research Groups at NTU and Co-director of the EPSRC-funded Centre for Industrial Energy, Materials, and Products.

Nicole Darnall is a Professor of Management and Public Policy at ASU in the School of Public Affairs and the School of Sustainability. She is Associate Director of ASU's CORD and team leader of the Sustainable Purchasing Research Initiative (SPRI). Her research focuses on factors that facilitate or impede the enactment of organizational sustainability and individuals' sustainability behaviors. Learn more about SPRI's research at spa.asu.edu/spri.

Lisa F. Daugherty is a Project Manager/Senior Environmental Scientist at Kleinfelder, Inc. in Mount Dora, Florida. She earned her M.S. in Environmental Science and Policy at the University of South Florida.

Aaron Deslatte is an Assistant Professor of Public Administration and a Faculty Affiliate at the Institute for the Study of Environment, Sustainability, and Energy at Northern Illinois University, USA. His research revolves around local government management and innovation, land-use policy and development, the environment, and social equity.

Cornelia Diethelm is the Director of Sustainability & Issue Management at Migros and Board Member of Öbu, the Swiss network for sustainable management. She has two Master's degrees in Political Science, Business and Economics, and Corporate Communications Management.

Marc Edwards is the Charles P. Lunsford Professor of Civil and Environmental Engineering at Virginia Tech. In 2016 Edwards was named among the most influential people in the world (Time), greatest thinkers in the world (Foreign Policy), greatest leaders in the world (Fortune), and people most influencing politics in the world (Politico). Edwards is a MacArthur Fellows (2007) and has won numerous awards for defending the public interest at great personal risk.

Catherine Fisher is the Assistant Director of the Faculty Computing Services Department at Hofstra University and an adjunct faculty member in the Information Systems and Business Analytics Department. At the university, she supports the assessment efforts and the classroom technology for the faculty as well as the administration. Before joining Hofstra in 2006, Ms. Fisher worked as a systems analyst at the New York Stock Exchange for over ten years. She received her M.B.A. from St. John's University and M.S.Ed. at Hofstra University.

Deborah Rigling Gallagher is an Associate Professor of Resource and Environmental Policy at Duke University. Her research focuses on public policies at the intersection of business and the environment, and more specifically on public-private partnerships for sustainability. She is a leading scholar of environmental leadership, having edited the SAGE Reference Handbook of Environmental Leadership. She is the former Director of Duke University's Environmental Leadership program.

Aimee C. Gibbons, Ph.D. was awarded her doctorate in Earth System Science from the University of California, Irvine. Her research applies geostatistical techniques to in situ and Earth observations to characterize responses in groundwater quality to increased use.

David Gibbs is a Professor of Human Geography at the University of Hull. His main research interests are focused on the political economy of the environment and on economy-environment interrelationships. He is particularly

interested in exploring the policy implications of these interrelationships, especially at the local and regional level.

Melissa Grigione is a Professor in the Biology Department at Pace University in New York. She earned her Ph.D. in Ecology at UC Davis and concentrates her research in mammalian spatial ecology, emphasizing conservation biology for species whose populations have been seriously altered as a consequence of habitat degradation and fragmentation. She is co-author of numerous peer-reviewed papers and articles and the recipient of more than a dozen grants and fellowships.

Christopher V. Hawkins is an Associate Professor in the School of Public Administration at the University of Central Florida, USA. His research focuses on regional governance, political institutions, and urban sustainability policy.

Kirsten Holmes is an Associate Professor and the Co-director of the Tourism Research Cluster at Curtin University, Australia. Her expertise is in volunteering in leisure, tourism, events, and festivals, and she is the lead author of *Events and Sustainability* (Routledge, 2015). Most recently, she conducted research for the International Olympic Committee on the volunteer legacies of the Sydney and London Olympic Games.

Lily Hsueh is an Assistant Professor of Public Policy at ASU's School of Public Affairs. She is a CORD Senior Affiliate and Senior Sustainability Scientist at ASU's Julie Ann Wrigley Global Institute of Sustainability. Her research focuses on the emergence, evolution, and impacts of voluntary programs and market-based policies across policy issue areas, such as climate change, toxic chemicals, ocean and marine resources, and sustainable purchasing.

Heidi Hutner is an Associate Professor of Sustainability and English, Director of the Sustainability Studies Program, and Associate Dean in the School of Marine and Atmospheric Sciences at Stony Brook University. She writes about women and the environment, environmental justice, environmental humanities, and nuclear history. Hutner has published books with Oxford University Press, University of Virginia, and she publishes widely in anthologies and at news sites such as *New York Times*, *Ms.* Magazine, and others. Hutner's current book project, *Accidents Can Happen: Women in Nuclear History, Film, and Culture*, looks at the role of women and gender in nuclear stories. Hutner's website: HeidiHutner.com

Ralf Isenmann, Ph.D. is a Professor of Business Administration in Innovation and Technology Management at the Wilhelm Büchner Hochschule—University of Applied Sciences, Pfungstadt/Darmstadt (Germany)—and a Professor at the Institute for Project Management and Innovation (IPMI) University of Bremen (Germany), Faculty of Business Studies and Economics. Further, he is a Professor of Sustainable Management and Innovation at the University for Sustainable Development Eberswalde (HNEE). Prior to this, he was a Professor for Sustainable Future Management, Faculty of Business Administration, Munich University of Applied Sciences. He studied Industrial Engineering, Management and Business Studies at the Technische Universität Kaiserslautern and received a Dr. rer. pol. (Ph.D.) in Business Administration. From the University of Bremen, he holds a Dr. rer. pol. habil. (Habilitation, venia legendi). His expertise and focus in research, projects, publications, and teaching is in the interface between Technology and Innovation Management—in particular, technology foresight methods like Delphi and road mapping—and Sustainability Management, in particular Industrial Ecology Management and ICT-based Sustainability Reporting.

Adrienne L. Katner is an Assistant Professor in Environmental and Occupational Health at Louisiana State University School of Public Health, USA. Her research on lead in water resulted in a statewide policy change to require water testing during home inspections of lead-exposed children. In 2015, New Orleans non-profits recognized her with a Katrina Hero Award for Environmental Justice. Most recently, Dr. Katner has been involved in raising awareness about the lack of education to rural low-income residents reliant on groundwater as their potable water source.

Sarah Kettley is a Reader in Relational Design within the Product Design subject area at Nottingham Trent University, UK. Her research is concerned with how networks of things can be designed for networks of people. She is a member of the Design for Health and Wellbeing, and the Digital Craft and Embodied Knowledge Research Groups at NTU, and represents the University as a member of the steering group for the international Arcintex research network. She is an elected council member of the Design Research Society and convenes the tentSIG special interest group in tangible, embedded, and networked technologies. She received her doctorate from Edinburgh Napier University in 2008 and is a Fellow of the Higher Education Academy.

Kristina Kleinlercher is a Research Assistant and Doctoral Candidate at the Institute of Retail Management, University of St. Gallen. Her research inter-

ests are Cross-Channel Management, Digital Marketing, and Sustainability Management.

Johanna Kovarik, Ph.D. received her doctorate in Geography and Environmental Science and Policy in 2015 from the University of South Florida. Her primary research focuses on the impacts of human use of natural landscapes, groundwater vulnerability, and karst hydrogeology. She was the recipient in 2016 of the Forest Service's Rise to the Future for Excellence and Leadership Friend of the Fish/Watershed for her work with karst watersheds. She currently serves as a National Program Lead for the US Forest Service and has worked for the agency for over 14 years.

Rachel M. Krause is an Associate Professor in the School of Public Affairs and Administration at the University of Kansas. Her research focuses on issues of local governance, urban sustainability, climate protection, and community perceptions and acceptance of innovative environmental technologies. Her research on "Integrated City Sustainability: Administrative Apparatus for Overcoming Collective Dilemmas of Agency Fragmentation" is funded by the National Science Foundation's Science of Organizations program.

Yanna Lambrinidou is an Adjunct Assistant Professor of Science and Technology in Society at Virginia Tech and founder of the non-profit environmental health organization Parents for Nontoxic Alternatives. She served on the US EPA's National Drinking Water Advisory Council (NDWAC) LCR Workgroup and the CDC's Education and Communication Workgroup of the National Conversation on Public Health and Chemical Exposures. Her work has highlighted unethical industry-government practices and challenged paradigms in public participation in science and policy.

Margaret Linehan has an MBA in Sustainability from Antioch University. She has worked over 25 years in the Information Technology Finance divisions of numerous financial institutions, including Goldman Sachs, ING, ABN and Royal Bank of Scotland, and is currently working at the non-profit Social Impact Exchange. She initiated Goldman Sachs Brooklyn Recycling Program and worked on the Environmental Committee of the Park Slope Food Coop.

Rurik List is a conservation biologist working on the ecology and conservation of carnivores and species at risk, as well as in species' reintroductions and identification of conservation priorities. He created the Janos Biosphere Reserve—Mexico's first federal protected area created with the objective of protecting native grasslands—and is Head of the Research Area on

Conservation Biology at the Universidad Autónoma Metropolitana-Lerma in Mexico.

Judith Mair, Ph.D. lectures in Event Management in the Tourism Cluster of the UQ Business School, University of Queensland, Australia. Her research interests include events and sustainability, in particular greening of events and festivals, and the impacts of events on community and society. Her recent projects have focused on researching the links between events and social capital, examining the potential for events to act as spaces for pro-environmental behavior change and assessing the potential impacts of climate change on the tourism and events sector.

J. C. Martel is a Doctoral Student in the School of Public Affairs and Administration at the University of Kansas and Analyst for the City of Kansas, Missouri. Her work focuses on policy and program development guided by statistical and spatial modeling of energy, water, and greenhouse gas emissions. Her research uses institutional analysis and policy process theories to explore sustainability and climate change policy issues.

Abraham R. Matamanda is a registered full-time Ph.D. student in the Department of Urban and Regional Planning, University of Free State in South Africa. He holds Master's degree in Social Ecology from the Graduate Centre for Applied Social Studies and a BSc Honours degree in Rural and Urban Planning. Both degrees were obtained from the University of Zimbabwe. Abraham's Ph.D. study focuses on emerging human settlement forms and urban dilemma nexus focusing on water, sanitation, public transport, and security issues. He is a keen researcher and emerging academic who has shown his interest in research work through publications in peer-reviewed local and international journals such as *City, Territory and Architecture*, *Regional Development Dialogue*, and *Zambezia*, among others. Specifically Abraham's researches focus on urbanization, sustainability, environmental planning, rural development, and the planning of cities and towns.

Anna Metaxas, Ph.D. is a Professor in Oceanography at Dalhousie University. Her research focus is on factors that regulate marine populations from shallow water to the deep sea, in tropical and temperate regions. She is particularly interested in population connectivity, as it relates to conservation.

Corey Morris, Ph.D. is a scientist at Fisheries and Oceans Canada. His research is largely applied toward measuring population connectivity, MPA effectiveness, and environmental impacts of marine industries.

Liaison Mukarwi holds a BSc Hons in Rural and Urban Planning from the University of Zimbabwe. Liaison is a freelance researcher whose researches focus on Urban Management and Governance, Environmental Design, Housing and Community Issues, and Transport and Sustainability issues.

Ishani Mukherjee is a Research Fellow (Adj.) at the Institute of Water Policy and the Lee Kuan Yew School of Public Policy (LKYSPP), National University of Singapore. She received her Ph.D. in Public Policy, with a focus on Environmental Policy and was the recipient of the World Future Foundation Ph.D. Prize for Environmental and Sustainability Research in 2014. She also received the Asia-Pacific Journal of Public Administration Best Article Prize for 2016 and the Policy and Politics Ken Young Best Paper Award for 2015, along with her co-authors. Widely published, Ishani's research interests combine policy design and policy formulation, with a thematic focus on policy instruments for environmental sustainability, renewable energy, and energy efficiency, particularly in Southeast Asia. She worked previously at the World Bank's Energy Practice in Washington, D.C., on formulating guidelines and evaluating projects related to renewable energy, rural electrification, and energy efficiency. She obtained her M.S. degree in Natural Resources and Environmental Economics from Cornell University.

Nora Munguia, Ph.D. holds a doctoral degree from the University of Massachusetts Lowell in the field of Cleaner Production and Pollution Prevention. She is a Senior Professor/Researcher in Sustainability Issues at the University of Sonora, Mexico. She is coordinator of the sustainability graduate program, professor, and researcher in the University of Sonora in Mexico and adjunct professor in the University of Massachusetts Lowell. She also is a member of the Mexican Research System.

Yumiko Nakanishi is a Professor of European Union Law at the Graduate School of Law, Hitotsubashi University, Tokyo, Japan. She obtained Master of Law (Hitotsubashi University 1993), Magister Legum (University of Münster, Germany, 1995), and Doctor of Law (University of Münster 1998). Her areas of research are EU environmental law, EU constitutional law, and EU external relations law. She is the author of numerous books and articles including the following books: *Y Nakanishi* (ed.), *Contemporary Issues in Environmental Law*, Springer 2016.

Leslie A. North, Ph.D. is an Associate Professor of Environmental Geoscience in the Department of Geography and Geology at Western Kentucky University (WKU). She serves as the Associate Director for Education and Outreach in the WKU Center for Human GeoEnvironmental

Studies (CHNGES). Her research interests focus on the development of effective informal learning education materials and techniques, particularly those related to water resources, climate change, sustainability, ecotourism, and karst landscapes.

Thaddeus Chidi Nzeadibe, Ph.D. is a Senior Lecturer in the Department of Geography and also the Coordinator of the Waste & Resource Management Research Group (WARMREG), University of Nigeria, Nsukka, Nigeria. He obtained a doctorate in Environmental Management and has published in some top journals in environment and development. He is co-editor of the book *Dealing with waste: Resource Recovery and Entrepreneurship in Informal Sector Solid Waste Management in African cities* (Trenton, NJ: Africa World Press, 2017) and currently serves as editor in the journal *Cogent Environmental* Science. Email: chidi.nzeadibe@unn.edu.ng

Friday Uchenna Ochenna is from the Department of Geography and Environmental Management, University of Port Harcourt, Nigeria. He is currently a doctoral student at the Chinese Academy of Sciences, Beijing, under the CAS-TWAS President Fellowship. He has some peer-reviewed publications to his credit. Email: uchenna.ochege@uniport.edu.ng

Kirstie O'Neill is a Fellow in Environment at the London School of Economics and Political Science. Kirstie's research interests focus broadly on sustainability, in particular sustainability transitions, alternative food systems, and green building. She is also interested in policy networks and governance for sustainability.

Sheetal Patil is a Researcher at Azim Premji University, Bangalore. With formal training in engineering and computer applications, her research interest is in policy impacts on agricultural sustainability and its assessment at micro level. Using the lens of sustainability, she focuses on agrarian and related issues that range from natural resource management to food security to livelihood sustenance to alternate institutions to safeguarding traditional and cultural knowledge. For more details and other publications: http://azimpremjiuniversity.edu.in/SitePages/sheetal-patil.aspx.

Diane M. Phillips, Ph.D. is a Professor of Marketing at Saint Joseph's University in Philadelphia. Dr. Phillips is also a Guest Professor at the Institute for Retail Management at the University of St. Gallen, Switzerland. She received her doctorate from Penn State University and focuses her research in the broad area of sustainability and marketing strategy. Dr. Phillips has been writing, speaking, and doing research on sustainability for more than 20 years and recently became a certified member of the Climate Reality Leadership

Corps, an elite group of thought leaders that have been trained by former Vice President Al Gore to deliver The New Climate Reality presentation. Each semester, she teaches several classes on the topic of sustainability at the graduate and undergraduate levels. She also speaks to national and international conferences, businesses, and universities on the topic.

Jason Keith Phillips, Ph.D., C.T.L. earned a doctorate in Management Science, Operations, and Logistics from Penn State University. His research has appeared in numerous prestigious international journals including the *Journal of Business Logistics*, the *International Journal of Physical Distribution and Logistics Management*, and the *Transportation Journal*. With over 20 years of teaching experience, Phillips is currently a Professor of Marketing at West Chester University in West Chester, Pennsylvania. Dr. Phillips has also developed and leads numerous highly successful student study tours, both international and domestic, annually.

Kelsey Pieper is a USDA-NIFA Postdoctoral Fellow in the Civil and Environmental Engineering at Virginia Tech and a member of the Flint Water Study Team at Virginia Tech. Her research focuses on lead exposure in drinking water and evaluating the effectiveness of common remediation practices. Her work has brought national attention to water quality challenges experienced by low-income rural populations—problems that are often associated with less regulated small community water systems, and unregulated systems, such as private wells.

Pierre Pepin, Ph.D. is a Senior Oceanographer and Quantitative Ecologist at Fisheries and Oceans Canada. His research focuses on population connectivity, prey-predator dynamics, community-habitat relationships, climate change, and development of ecosystem-based approaches to management.

Seema Purushothaman is a Professor at Azim Premji University. She uses interdisciplinary approaches to study social, ecological, and economic change in livelihoods and policies in India, investigating their linkage to food and agrarian crises. Her research spans across the concept and issues of sustainability in and around forests and family farms. Her teaching interest includes sustainability as a concept, as an agrarian concern, as well as from an economic perspective. For more details and other publications: http://azimpremjiuniversity.edu.in/SitePages/seema-purushothaman.aspx.

Nicole M. Radziwill is an Associate Professor of Integrated Science and Technology (ISAT) at James Madison University (JMU). She is a Fellow of the American Society for Quality (ASQ), a Certified Six Sigma Black Belt

(CSSBB), and Certified Manager of Quality and Organizational Excellence (CMQ/OE) and one of ASQ's Influential Voices (http://qualityandinnovation.com). She is the author of *Statistics (The Easier Way) with R* and *End-to-End Solved Problems with R*. Her research emphasizes quality, innovation, and design in production systems, in particular, cyber-human and cyber-physical systems.

R. M. Wasantha Rathnayake, Ph.D. is a Professor and an Environmentalist. His research interest is recreational planning. He has published several ecotourism planning studies applying the travel cost method and the contingent valuation method. At present, he is Dean of Faculty of Management Studies at the Sabaragamuwa University of Sri Lanka.

Daniel R. Rondinel-Oviedo has an MSc in Architecture with a major in Ecology (2011) at Cornell University in New York, USA; Fulbright Foundation Scholarship (2010–2011); Architect 2003, Ricardo Palma University with membership to the College of Architects of Peru (2007); LEED G.A. (2011); and EDGE Expert & EDGE Auditor (2016). In the professional field, he has 13 years of experience in design, coordination, management, and development of projects with specialization in architecture and sustainable building and he has worked in projects for public and private entities. In the academic field, he has 12 years of experience as a teacher: Professor of the Project Workshop course at the Ricardo Palma University (2005–2009); Assistant Professor for the School of Architecture, Art, and Planning at Cornell University (2010–2011) for the Environmental System 1 and 2 courses; and Professor of Architecture at the University of Lima for the courses on Environment and Natural Resources (since 2011), Project Development (since 2013), and Design Studio (since 2014). He has developed research on sustainability for the Institute of Scientific Research of the same university since 2015.

Mark Roseland is a Professor of Planning in the Graduate School of Resource and Environmental Management and Director of the Centre for Sustainable Development at Simon Fraser University, Vancouver, Canada. He lectures internationally and advises communities and governments on sustainable development policy and planning. Dr. Roseland has developed Pando.sc, a network for sustainable community researchers and practitioners. The 4th edition of his best-selling book *Toward Sustainable Communities: Solutions for Citizens and Their Governments* is published by New Society.

Thomas Rudolph is a Professor at the University of St. Gallen. He manages and directs the Institute of Retail Management and the partnership program Retail Lab. His research focuses on Consumer Behavior, E-Commerce, Cross-

Channel Management, and Strategic Retail Management. He has published more than 10 books and over 300 articles on the topics of Marketing and Retailing.

Jonathan Rushton is a Professor of Animal Health in the Royal Veterinary College, University of London. He is a member of the Veterinary Epidemiology, Economics and Public Health Group where he focuses on improving the well-being of people and animals through improved resource allocation to food systems and animal health, disease, and welfare problems.

Ellen Scully-Russ is an Associate Professor of Human and Organizational Learning at George Washington University, USA. She studies the changing nature of work, with a particular interest in understanding the complex dynamics giving rise to emerging occupations. She has authored numerous award-winning articles on the intersection of sustainability and human resource development, including "Human resource development and sustainability: Beyond sustainable organizations" in *Human Resource Development International* and "Green HRD: A social-environmental systems perspective of the role of HRD," in Volume 17 of *Advances in Developing Human Resources*.

Christian N. Ryan EDD is the Sustainability Coordinator at Western Kentucky University. She teaches courses for the MA in Social Responsibility and Sustainable Communities and the MBA in Sustainability Certificate. Her research interests include disruptive leadership, emergent leadership, organizational change for sustainability, and problem and place-based learning.

Ronald Sarno, Ph.D. is an Associate Professor in the Biology Department at Hofstra University in New York. He earned his doctorate in Ecology/Evolutionary Biology at Iowa State University. Much of his past research has focused on the population ecology, evolution, and behavior of mammals, especially the wild South American camelids due to his interest in mating systems, social behavior, population dynamics, and conservation.

Timothy M. Shaw is a Foundation Director and Visiting Professor in the Ph.D. in Global Governance and Human Security at the University of Massachusetts Boston with visiting/adjunct status at Aalborg and Stellenbosch Universities as well as in Canada: Carleton and Ottawa in Ottawa and Dalhousie and Saint Mary's in Halifax. He continues to edit series on IPE for Palgrave Macmillan (www.palgrave.com/series/13996) and Routledge (www.routledge.com/series/ASHSER1146) (timothy.shaw@umb.edu).

Paul Snelgrove, Ph.D. is a Marine Ecologist and Professor of Ocean Sciences and Biology at Memorial University of Newfoundland. He also serves as Director of the NSERC Canadian Healthy Oceans Network and Associate Director of the Ocean Frontier Institute. His research interests focus on marine biodiversity, ecosystem functioning, population connectivity, and ocean conservation.

Maria Spiliotopoulou is a Ph.D. Candidate in the School of Resource and Environmental Management and a Researcher in the Centre for Sustainable Development at Simon Fraser University, Vancouver, Canada. Her research focuses on the concept of urban productivity as an alternative way to approach sustainable community development theory and practice.

Ryan Stanley, Ph.D. is a Quantitative Ecologist and Research Scientist working with the Department of Fisheries and Oceans Canada at the Bedford Institute of Oceanography. Dr. Stanley's research program focuses on the design and monitoring of MPAs and MPA networks in the Northwest Atlantic. His research interests focus on population connectivity, fisheries ecology, climate change, and habitat science.

Justin M. Stritch is an Assistant Professor of Public Management at ASU's School of Public Affairs. He is CORD Senior Affiliate and Research Fellow at SFI—The Danish National Centre for Social Research. His research focuses on employee motivation, management, performance, and decision-making in public organizations. He applies these topics to a variety of settings, including how organizations can encourage workplace participation in pro-environmental behavior.

Elizabeth Strom is an Associate Professor in the School of Public Affairs, University of South Florida. Her work focuses on urban issues such as downtown redevelopment and housing.

Wilma Subra is the President of Subra Company and the Technical Advisor to Louisiana Environmental Action Network. She provides technical assistance to community groups dealing with environmental and human health issues and serves on federal, state, and local advisory groups representing citizen issues and situations. She received the MacArthur Genius Award in 1999 for helping ordinary citizens to understand, cope with, and combat toxic chemicals in their communities.

Kyungeun Sung, Ph.D. is a Lecturer in the School of Design, De Montfort University (DMU), UK. She recently received a doctorate degree in the School of Architecture, Design and the Built Environment, Nottingham Trent University (NTU), UK. Her Ph.D. research is about sustainable pro-

duction and consumption by upcycling, which is part of the EPSRC-funded Centre for Industrial Energy, Materials and Products. Before undertaking a job at DMU, Kyungeun worked as a Research Associate/Fellow in Upcycling, Design and Business Management for an interdisciplinary research project between the School of Architecture, Design and the Built Environment and Nottingham Business School at NTU. Kyungeun's current research focuses on scaling up upcycling across industries. Her general research interest is in sustainable production and consumption focusing on sustainable design.

Brian F. Thomas is an Assistant Professor in the Department of Geology and Environmental Science at the University of Pittsburgh. His research focuses on coupled human/natural systems with a particular interest on watershed storage and groundwater/surface water interactions. His work combined Earth observation data and in situ records with statistical techniques to evaluate anthropogenic influences using rigorous quantitative methods.

Velazquez Luis, Ph.D. has 26 years of experience as Industrial Engineer, and since 1994 he has served as Director of Sustainable Development Group in the Engineering College at the University of Sonora. He is Senior Researcher in the Sustainability, Cleaner Production, and Pollution Prevention fields. Dr. Velazquez holds a doctoral degree in the major of Cleaner Production and Pollution Prevention from the University of Massachusetts Lowell. He is a Professor and Researcher in the University of Sonora in Mexico and Adjunct Professor in the University of Massachusetts Lowell.

Thelma I. Velez is a Ph.D. student at Ohio State University (USA) in the School of Environment and Natural Resources. Her work has focused on various aspects of sustainability in both natural and social sciences. Some of her earlier research entailed carbon sequestration using biochar in organic agriculture settings and research on second-generation biofuel production in India. She is currently a National Science Foundation Graduate Research Program Fellow. Her dissertation focuses on alternative food movements, sustainable consumption, and pro-social behavior.

Haakon Vennemo is a Professor of Economics at Oslo Business School HIOA, Norway. His research focuses on energy and environmental economics in China.

Jo-Ansie van Wyk is a Professor of International Politics in the Department of Political Sciences, University of South Africa, Pretoria, South Africa. She has published widely on political leadership, nuclear diplomacy, and foreign policy. Her recent research has focused on nuclear geography, nuclear diplo-

macy, and energy. She has co-authored a number of books and authored a number of chapters in books and articles.

Salman Zafar is the Founder of EcoMENA, and an international consultant, ecopreneur, and journalist with expertise in waste management, waste-to-energy, renewable energy, environment protection, and sustainable development. His geographical areas of focus include Middle East, Africa, Asia, and Europe. Salman has successfully accomplished a wide range of projects in the areas of biomass energy, waste-to-energy, recycling, and waste management. Salman is a professional environmental writer with more than 300 popular articles to his credit. He is proactively engaged in creating mass awareness on renewable energy, waste management, and environmental sustainability all over the world.

Sascha Zinn, Ph.D. is a Research Assistant at the Center for Innovation in Teaching and Higher Education at the Munich University of Applied Sciences. As an educationalist specialized in Adult Education and Education for Sustainable Development, he is in charge of developing innovative teaching approaches and a concept for Education for Sustainable Development for the Munich University of Applied Sciences. Supported by a scholarship from the "Foundation of the German Economy," he did his dissertation at the University of Würzburg (Germany) in 2012. In Würzburg, he studied education, sociology, and psychology. His main research is focusing on higher education, organizational development, and sustainable future management.

Contents

List of Figures

List of Tables

1

Sustainability Definitions, Historical Context, and Frameworks

Sandra J. Garren and Robert Brinkmann

Different experts and organizations define sustainability in different ways. This introductory chapter discusses these definitions and reviews the development of the field of sustainability since it emerged from the United Nations in the 1980s in order to provide context for the chapters that follow. Additionally, the chapter highlights how sustainability brings together important themes of environment, economics, and social equity to try to limit the impact of human activity on the planet. We highlight how sustainability is assessed and measured by summarizing a number of local, national, and international assessment schemes used in a variety of contexts. We also consider how the three pillars of sustainability (environmental protection, economic development, and social equity) are key to each of the case studies presented in this book.

One overarching goal of this book is to define the field at the present moment. This text is a useful indicator of the state of sustainability at this pivotal time in our history in which the world is dealing with issues such as global climate change, environmental justice challenges, economic globalization, and environmental contamination. The book comprehensively looks at how distinct themes of sustainability are managed along with how they are managed together.

S. J. Garren (✉) • R. Brinkmann
Geology, Environment, and Sustainability, Hofstra University, Hempstead, NY, USA

R. Brinkmann, S. J. Garren (eds.), *The Palgrave Handbook of Sustainability*,
https://doi.org/10.1007/978-3-319-71389-2_1

As we consider how the world is changing, society will look more and more to sustainability experts to try to find solutions to our emerging problems. This book is an important contribution that provides examples on the best practices on sustainability and highlights lessons learned and continued barriers and challenges related to sustainability.

Sustainability Definitions

The definition of sustainability and sustainable development remains contested in many academic quarters, and there is a lack of a consistent definition within organizations in the academic literature. To explore the definitions, let's start with a dictionary definition. Merriam-Webster defines sustainable in three ways:

> *"capable of being sustained"; a "method of harvesting or using a resource so that the resource is not depleted or permanently damaged"; and, "a lifestyle involving the use of sustainable methods"* (Merriam-Webster n.d.)

From this definition, one might conclude that to be sustainable, a practice simply needs to continue over a given length of time or that we can use a resource as long as we don't use it all up or cause harm in the process. While the definition is a good starting place, the definition is problematic because for one it uses the term in the definition itself and because it leaves the reader without a working knowledge of what it means to be sustainable. For example, what lifestyle is considered sustainable? The United States Environmental Protection Agency (US EPA) offers up an expanded definition of sustainability:

> *Sustainability is based on a simple principle: Everything that we need for our survival and well-being depends, either directly or indirectly, on our natural environment. To pursue sustainability is to create and maintain the conditions under which humans and nature can exist in productive harmony to support present and future generations.* (US EPA n.d.)

This definition is much more useful since it brings together the many elements of the current field of sustainability which sprung into existence in the 1980s as a result of meetings conducted at the United Nations.

The term "sustainable development" was defined globally during the United Nations (UN) World Commission on Environment and Development (WCED) (United Nations 1987). This classic definition was published in the outcome document called *Our Common Future* (or the Brundtland Report as it is sometimes referred) and reads as follows:

> *Sustainable development is development which meets the needs of current generations without compromising the ability of future generations to meet their own needs. It contains within it two concepts: the concept of needs, in particular the essential needs of the world's poor, to which overriding priority should be given, and the idea of limitations imposed by the state of technology and social organization on the environment's ability to meet present and future needs....* (United Nations 1987, 41)

This definition contains a number of key items worth examining. Firstly, the definition contains the word development which is absent from the two definitions presented above. So, what does development actually refer to? Typically, one thinks of economic development but in this definition, people are highlighted as part of the development definition. Secondly, the definition highlights the concept of needs with a focus on the needs of the poor who clearly are not getting basic needs met. Beyond basic needs though, the concept of needs differs from person to person and the definition does not define what at what level of needs should be met. Should society attempt to meet only the basic need or all the needs of a human being through self-actualization as presented in Maslow's Hierarchy of Needs (Fig. 1.1)?

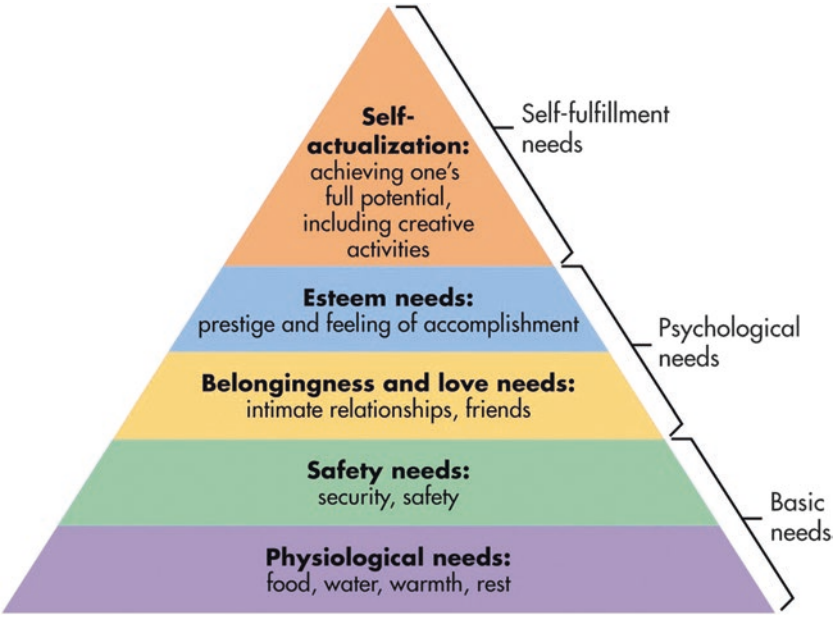


Fig. 1.1 Maslow's hierarchy of needs (Source: https://www.simplypsychology.org/maslow.html)

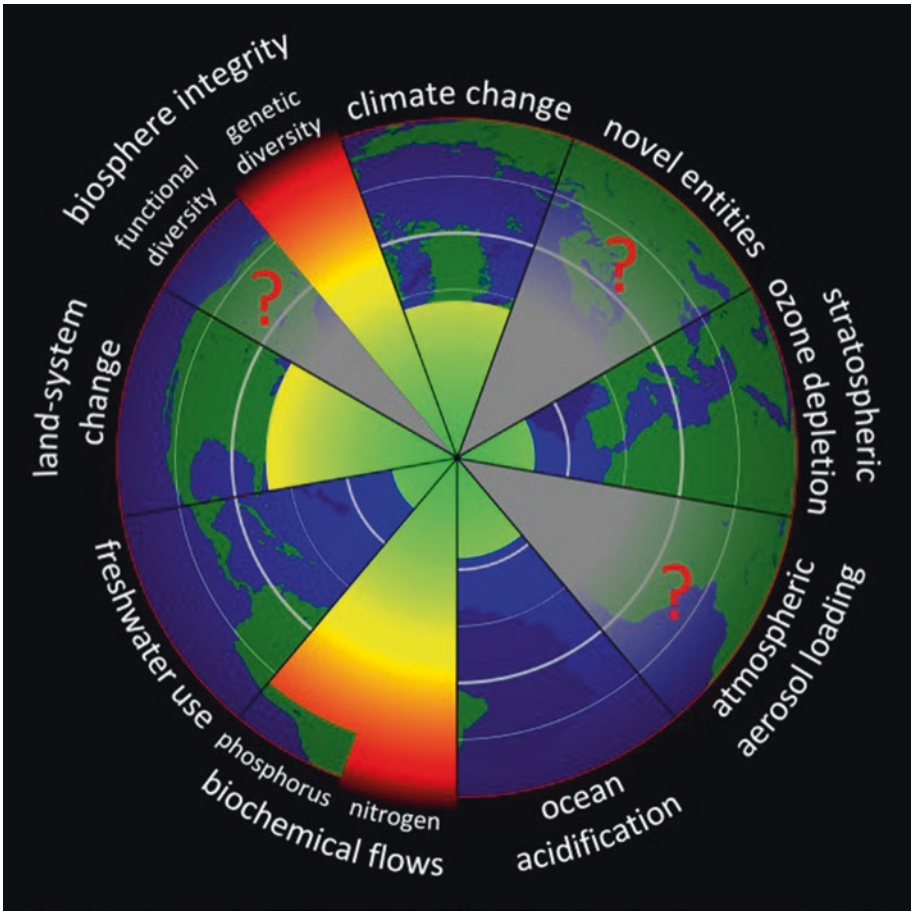


Fig. 1.2 Planetary boundaries according to Rockstrom et al. 2009 and Steffen et al. 2015 (Source: https://en.wikipedia.org/wiki/Planetary_boundaries#/media/File:Planetary_Boundaries_2015.svg)

The third concept in the definition is that of limitations and points specifically to limitations on the environment. Researchers have been studying planetary boundaries for decades and have identified nine environmental limits that society must prevent crossing to ensure the sustainability of our planet (Steffen et al. 2015; Rockstrom et al. 2009). As shown on Fig. 1.2, four of the nine boundaries have been crossed, namely, climate change, biodiversity loss, excessive phosphorus and nutrient loading, and land use system change.

Three balanced pillars often conceptualize sustainable development: environmental protection, economic growth, and social equality, sometimes referred to as the three E's (environmental, economic, and social) (Fig. 1.3).

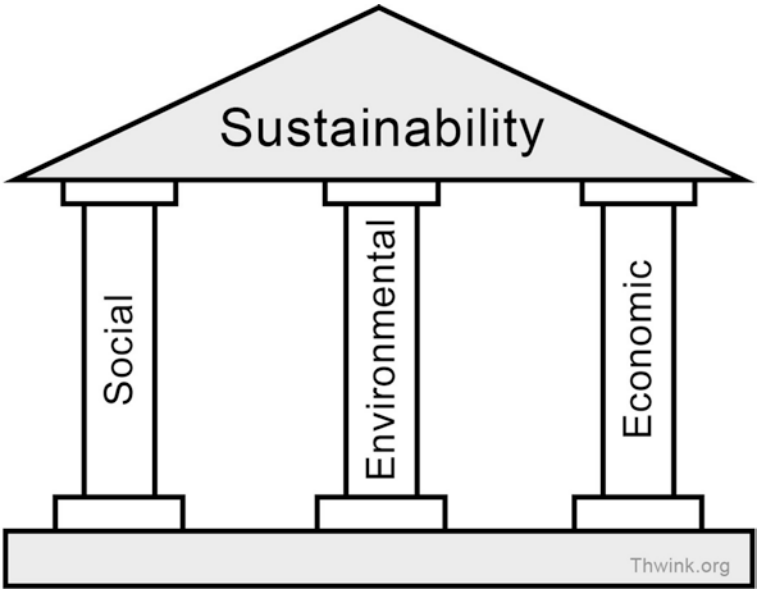


Fig. 1.3 The three pillars of sustainability (Source: http://www.thwink.org/sustain/glossary/ThreePillarsOfSustainability.htm)

The three E's were presented in 2002 at a UN Conference, World Summit on Sustainable Development (WSSD), and were intended to be interdependent and mutually reinforcing (United Nations 2002). However, many practitioners in the field still view the three E's as separate silos and look for solutions to disparate problems in isolation of the other two pillars.

Even with the specific sustainable development definition advanced by the United Nations, the ambiguous nature of the definition has resulted in organizations and institutions projecting "their interests, hopes and aspirations onto the banner of sustainable development" (Kates et al. 2005) which has led to a proliferation of practical definitions. For example, Johnston et al. (2007) identified 140 altered or variously modified definitions of sustainable development. It is clear that the lack of a unified definition of sustainability may hinder the ability to comprehensively assess sustainability, and there have been recent attempts to develop a unified definition. For example, Moore et al. (2017) reviewed over 200 research studies, identified 24 unique definitions of sustainability, and, from those definitions, identified five distinct yet interrelated constructs that include time, continued delivery, behavior change, evolution/adaption, and continued benefits. The proposed unifying definition is as follows:

> *After a defined period of time, a program, clinical intervention, and/or implementation strategies continue to be delivered and/or individual behavior change is maintained; the program and individual behavior change may evolve or adapt while continuing to produce benefits for individuals/systems.* (Moore et al. 2017, 6)

Moore et al. (2017) intend to use this definition to develop a meta-framework to consolidate factors across the numerous sustainability frameworks. Whether this unifying definition is useful to practitioners is unclear. Not all sustainability researchers agree that having a unified definition would help advance sustainability given the complexity of such a definition and advocate that a simpler definition allows for flexibility when assessing unique and complex sustainability initiatives and programs (Dale and Newman 2005). Another criticism of the lack of a universal definition is that it becomes difficult to assess sustainability if there are many definitions and it provides organizations leeway to selectively decide what to measure. This certainly is true given the numerous sustainability frameworks and assessment tools currently available.

One of the best ways to understand the development of complex issues associated with sustainability is to take a deep dive into the history of the field within the United Nations. No organization on the planet has had so much influence on the topic. The work of the UN informed most of the efforts of national, state, and local governments as well as the work of private and nonprofit organizations. As we will see, the United Nations also influences how we as individuals try to lessen our impact on the planet.

The United Nations and Sustainability

While there are antecedents to the modern sustainability movement that can be traced from Henry David Thoreau to Rachel Carson, it was not until the late 1980s that sustainability was brought to the forefront as a result of a landmark United Nations meeting and the publishing of the Brundtland Report. In fact, national meetings and conferences through United Nations have progressively moved the sustainability field forward since at least 1972. This progression of actions taken at the United Nations and their significance is briefly presented below.

1972 United Nations Conference on the Human Environment

This conference was held in Stockholm and was the first United Nation conference to examine the relationship between economic development and envi-

ronmental degradation (United Nations 1972). Probably the most significant outcome of this meeting was the creation of the United Nations Environment Programme (UNEP) which is a division of the United Nations that to this day holistically addresses environmental problems around the world. The current focus areas of UNEP are climate change, disasters and conflicts, ecosystem management, environmental governance, chemicals and waste, resource efficiency, and environmental review. The last focus area examines new and emerging environmental problems, including antimichrobial resistence, threats from nanomaterials, restoring marine protected areas, subduing sand and dust storms, and supporting off-grid electricity to the nearly one billion people on this planet without electricity (UNEP 2017).

1983 United Nations World Commission on Environment and Development (WCED)

This conference was held in Norway and as described previously the conference resulted in the development of the concept of sustainable development through the Brundtland Commission, named in honor of the Norwegian Commissioner, Gro Harlem Brundtland. The Brundtland Commission was formed at the 1983 WCED and the outcome document, *Our Common Future* (or more popularly referred to as the Brundtland Report), was published a few years later in 1987 (United Nations 1987). Of course, this meeting was significant because a working definition of sustainable development was conceptualized and presented to the world.

1992 United Nations Conference on Environment and Development (UNCED)

This conference was recommended by the Brundtland Commission with the intention of providing concrete actions toward sustainable development. The conference is often referred to as the Earth Summit, was held in Rio de Janeiro, and resulted in a number of outcomes (United Nations 1992). First, the United Nations Commission on Sustainable Development (CSD) was formed (which was reformed into a high-level political forum 20 years later). Second, three significant agreements resulted from this meeting: (1) the Rio Declaration which contains 27 principles that collectively define the rights of states, (2) Agenda 21 which lays out a series of actions toward sustainable development, and (3) the Statement of Forest Principles which define global sustainable forestry practices. Thirdly, in addition to these three agreements, two legally binding conventions

were formed: The United Nations Framework Convention on Climate Change (UNFCCC) and the Convention on Biological Diversity (CBD). The UNFCCC was created to develop, facilitate, and enforce international climate change treaties. The first treaty the UNFCCC developed was the Kyoto Protocol which was adopted in 1997 and ended in 2012. Its successor, the Paris Agreement, entered into force in 2016. The Intergovernmental Panel on Climate Change (IPCC) is an international organization that supports the UNFCCC's mission by providing regular scientific assessments on climate change from thousands of scientists from around the world. The CBD is a multilateral international treaty with goals to conserve biological diversity, ensures the sustainable use of biological resources, and strives for fair and equitable sharing of genetic resources.

1994 United Nations Conference on Small Island Developing States (SIDS)

This conference held in Barbados highlighted the unique vulnerabilities and challenges in small island states (United Nations n.d.). The conference was significant because it brought awareness and special attention to SIDS which led to inclusion and special attention in subsequent conferences. For example, these issues are highlighted in the 2012 outcome document, The Future We Want.

1997 United Nations Earth Summit +5

This summit convened five years after the Earth Summit and hence the name of the conference. This meeting was assembled to assess progress made by countries and organizations since the landmark Earth Summit held five years prior. The summit was significant in that goals were set to develop national strategies for all countries by the year 2002 (United Nations 1997). This goal-setting task set into motion financial and technical assistance for countries to complete national assessments. The early national assessments are still available on the United Nations platform and were organized into Agenda 21 focus areas.

2000 Millennium Development Goals (MDGs)

At the turn of the century, world leaders gathered to develop goals, known as Millennium Development Goals (MDGs) to primarily fight poverty. As a result, eight MDGs were advanced (Fig. 1.4). The MDGs were in effect for 15 years ending in the year 2015 (United Nations 2015). Through the 15 years, the MDGs initiated a process to assess nations using measurable indicators.

Fig. 1.4 Millennium development goals (Source: United Nations 2000; Infographic obtained from: http://un.dk/about-the-un/the-mdgs)

Much progress was achieved through these goals; however, many challenges still remain. The MDGs were not continued given the timing of the Sustainable Development Goals in 2012 (described below). The MDGs were significant in that they focused world leaders around a set of overarching goals toward addressing a specific global problem.

2002 United Nations World Summit on Sustainable Development (WSSD)

This conference was held in Johannesburg, South Africa, and is sometimes referred to as the Johannesburg Summit. This meeting was convened to address the continued global challenges that include eradicating poverty and protecting natural resources (United Nations 2002). An implementation plan was developed as a result. One key outcome was the development of national assessments and the development of sustainability indicators to assess progress. Another important outcome of the meeting was that the three E's of sustainability were specifically intended to be integrated and mutually reinforcing.

2012 United Nations Conference on Sustainable Development

This conference is often referred to as Rio+20 since it was held 20 years after the Earth Summit in Rio de Janeiro. This historic meeting of world leaders resulted in the development of 17 Sustainable Development Goals (SDGs)

Fig. 1.5 Sustainable development goals (Source: United Nations 2016, https://sustainabledevelopment.un.org/sdgs)

(United Nations 2012) (Fig. 1.5). Since the MDGs ended in 2015, the newly created SDGs would include and scale those goals into the new SDGs. One change though is that the SDGs would include not only poor countries but also all countries when addressing the world's sustainability problems since developing countries also have problems and are largely responsible for creating problems in other parts of the world.

Since Rio+20, the United Nations has developed a total of 169 goals and targets and 244 sustainability indicators to measure the progress toward achieving the 17 SDGs. The SDGs are significant in that a standardized system is not in place to quantitatively assess progress within each country. Through the newly developed Sustainable Development Knowledge Platform, reports and quantitative data are organized for all countries in the world (although there are still many data gaps that need to be filled). From this data, countries that have good data have been included into an SDG Index that ranks the countries according to cumulative progress toward the 17 goals (Sustainable Development Solutions Network 2017a).

The SDGs are significant in many ways. For one, the goals provide top-down aims with clear targets and indicators that each county could use to frame a national strategy. Conversely, the SDGs are being used to develop a bottom-up framework for institutions and organizations to determine their contribution and responsibilities for meeting the goals. For example, busi-

nesses are now including SDG information into their sustainability reports. Cities are also incorporating the SDGs into initiatives and will likely ramp up action based on a new City SDG Index that includes rankings for over 100 global cities (Sustainable Development Solutions Network 2017b). The SDG framework and databases are significant in that they provide a standardization of sustainability indicators with historical data all in one place which will provide academics and decisions-makers the ability to analyze and make data-driven decisions on sustainable strategies.

The history of the UN's sustainability initiatives outlines a progression of the development of the field from broad national-scale environmental and social improvement to a more complex scalable approach that includes all regions of the world. The history also highlights that some environmental problems, most notably climate change, are accelerating and that they lead to significant social equity and economic challenges. From this history emerged a number of sustainability frameworks to manage sustainability at national, regional, and local scales and in for-profit and non-profit entities. Some of the key frameworks are highlighted in the next section.

Sustainability Frameworks

Sustainability frameworks help to organize the practice and thinking about sustainability and provide a guide for decision-makers. The process of evaluating sustainability is generally referred to as sustainability assessment. Like the definition for sustainability and sustainable development, there is no agreement on the format and content of sustainability assessments (Sala et al. 2015; Pope et al. 2017). However, from the review of hundreds of sustainability assessments from government and business organizations, several key elements are common to assessment. In general, an organization may choose to begin with benchmarking their policies, practices, and performance to determine the current status of their operations. Often, benchmarking involves comparing the relative to a baseline or to similar organizations. Many organizations undergo a visioning process and resolutions, goals, and targets are designed to achieve the vision within a specified time period. Action planning is the next step where a set of initiatives are identified to meet the goals and targets. Then, the plan is implemented and after a set period of time, the initiatives are measured to check the progress and monitor if the action is actually meeting the goal. The field has led to the development of sustainability indicators that are unique data sets used to quantitatively measure progress of each goal or target. Sustainability

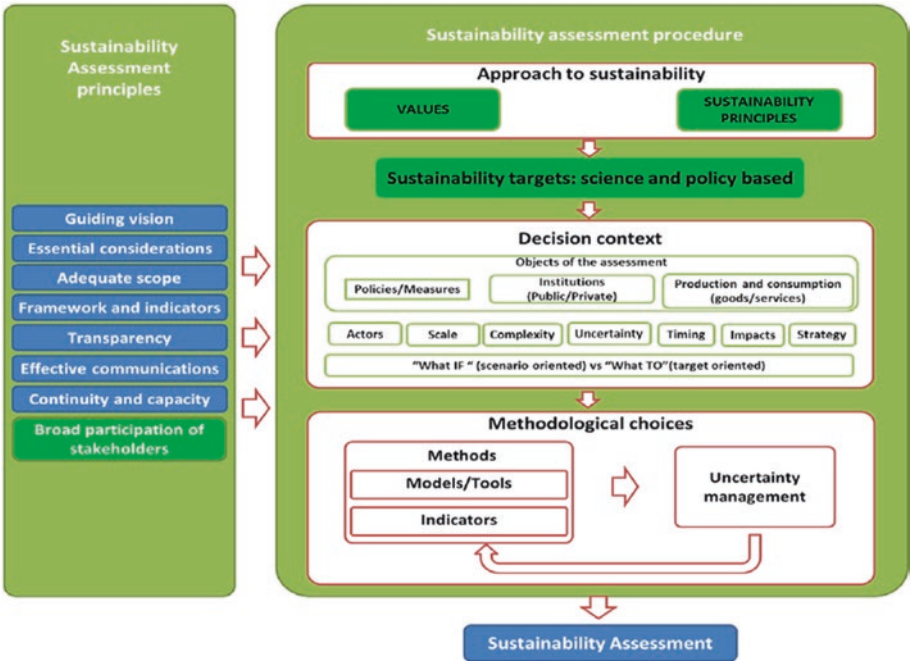


Fig. 1.6 Schematic representation of the conceptual framework for sustainability assessment (Source: Sala et al. 2015; https://www.researchgate.net/profile/Serenella_Sala/publication/283488239/figure/fig1/AS:292079307243520@1446648541190/Fig-1-Schematic-representation-of-the-conceptual-framework-for-sustainability.png)

assessment practices have become more and more complex over the last few decades as illustrated in Fig. 1.6 which in addition to the core elements presented above also includes stakeholder engagement, transparency, communication strategies, and uncertainty management.

Globally, there have been a number of frameworks and assessment tools that are used to determine the sustainability of a government, organizations (for-profit and not-for-profit), and personal sustainability. What follows is an overview of the most well-known frameworks in these categories.

National Frameworks

The United Nations began assessing governments' progress toward sustainable development beginning in the 2000s, and these assessments were uploaded for public viewing on the United Nations website. These reports are prepared

by each country and submitted for posting. Since each country has different issues and some may choose to only report positive sustainability progress and either not report or downplay national success. With the development of the 17 SDGs with 169 targets, and 244 sustainability indicators, these SDGs are being used as the framework to assess sustainability in nations. In fact, databases are being developed and a sustainability index has been developed.

Subnational Governments

Within nations, there has been a trend toward reporting or managing sustainability at a more regional scale. For example, in the United States, there are many states that come together to manage particular environmental issues such as sulfur dioxide or carbon dioxide emissions or manage water resources. These regional initiatives are often guided by specific shared environmental, social, or economic challenges. Individual states sometimes become national and international leaders. California, for example, is widely regarded as the leader in managing air pollution via state regulation that sometimes guides and defies United States law.

World cities have also become leaders. Some international city leaders like New York's former Mayor Bloomberg and Burlington Vermont's former Mayor Bernie Sanders focused their administrations on making their cities more sustainable in concrete, measurable ways. Leaders have emerged in large cities and small towns throughout the world. One organization, ICLEI - Local Governments for Sustainability (ICLEI), provides benchmarking opportunities and best practice case studies to help local governments of all sizes find the best way to achieve their sustainability goals. Another group, 100 Resilient Cities, works to create resiliency and concomitant sustainability in some key global cities.

Organizational Frameworks

In addition to governments, organizations have been leading a transition to more sustainable practices. This transformation has been exhibited in both for-profit and non-profit corporations and institutions. Economic motivations (triple bottom line) and a changing consumer base that is willing to pay more for green products and services drive some of the desire to utilize some of these frameworks. However, it is important to note that there are a number of professional and personal ethical considerations that help to advance these initiatives.

Table 1.1 Organizational sustainability frameworks

Framework	Purpose	Website
Global Reporting Initiative	Assesses impacts of business and governments on sustainability	https://www.globalreporting.org
Dow Jones Sustainability Index	Evaluates businesses on a scale based on sustainability performance	http://www.sustainability-indices.com/
The Natural Step	Uses a systems approach to assess sustainability of organizations	http://www.thenaturalstep.org/
Environmental, Social, and Governnance (ESG)	Provides guidance for investors to enhance wise governance, social equity, and sustainability	http://paxworld.com/
UN Global Compact	Provides leadership for business leaders to achieve goals of the Paris Climate Accord	https://www.unglobalcompact.org/

For example, it is becoming much more common for business organizations to look at the impact of their global operations on local communities.

There are a number of frameworks used by organizations. They include the Global Reporting Initiative, the Dow Jones Sustainability Index, The Natural Step, Environmental, Social, and Governance (ESG) factors, and the UN Global Compact. Each is briefly reviewed in Table 1.1. Each framework provides a way to assess the impact of a particular activity and to benchmark the activity against others. These frameworks create a way to set standards and develop competition to reach goals. They also provide a way to inform consumers about products and services.

Green Building

Perhaps one of the most visual impacts on sustainability over the last few decades is the move toward green building. A wide variety of benchmarking tools have emerged that provide architects, planners, builders, and consumers with choices. In the United States, LEED (Leadership in Energy and Environmental Design) was developed by the United States Green Building Council (USGBC) to assess individual homes, communities, renovations, and a wide variety of other structures. The scheme focuses largely on the building itself and its setting. BREEAM (Building Research Establishment Environmental Assessment Method) was developed in the United Kingdom and is similar to LEED, although BREEAM tends to focus more on the environmental outcome of the building. Comprehensive Assessment System for Built Environment Efficiency (CASBEE), a system developed in Japan, is similar. Passivhaus is another European building benchmarking tool that was developed in Germany

and Sweden. It mainly assesses the energy use of the building. It seeks to significantly reduce the need for energy inputs by sound design.

Personal Sustainability

Of course, there are also ways to assess our own personal sustainability. For example, we can measure our ecological or carbon footprint using a variety of tools to see how we measure up compared to others around the world. We can also measure our energy use or become green consumers by the use of external benchmarking systems such as those developed by the Rainforest Alliance. Many of us can choose to use renewable energy, eat organic and local food, conserve water, and get rid of our cars. Yet others have a form of enforced sustainability due to poverty, war, or other external factors. In many ways, there are two sustainabilities in the world: that of the West where sustainability is technological and focused on reducing consumption and that of the Global South where many are trying to improve conditions in ways that do not mimic the consumerist West.

Significance of Sustainability in the Modern Era

The previously discussed frameworks highlight that there are earnest initiatives taking place at all levels of society throughout the world that seek to limit the impact of humans across the planet. But we truly are at a crossroads of time. We are seeing impacts so significant that geologists have coined our current era the Anthropocene due to the profound changes we are seeing in all of our Earth's systems (Waters et al. 2016). As we have noted, we have crossed planetary boundaries that will likely lead to further planetary disruptions. We are seeing major changes to climate and to ecological systems. We are seeing social disruptions as a result of major storms, wars, and drought. Many worry about what we will face in the coming decades. Some feel powerless to act in the face of the profound issues we face. The environmental devastation in the Caribbean in the hurricane season of 2017 highlights how vulnerable we are to environmental change. As storms and climate extremes accelerate, can we find a way forward? Can we change our behavior to stop unsustainable behavior before it is too late?

Some have critiqued sustainability and its focus on frameworks and benchmarking as not entirely useful as challenges accelerate. They note that the very government and economic systems of the world promote inequality and end-

less consumption. Certainly, they have a point. The limited impacts of some recycling programs without a push to reduce consumption are good examples of how sustainability can lose track of broader goals and the Global North-South development divide clearly showcases inequality. However, there seems little likelihood that current global currents will change any time soon and it is irresponsible to pause sustainability initiatives to wait for fundamental structural changes in global society. Without the work of many to advance sustainability over the last few decades, we would be in a far worse situation than we are in today.

There are many examples of sustainability achievements that can be identified throughout the world. While some aligned with particular industries try to bring down agreements like the Paris Climate Accord, many others rush in to save it and start new initiatives. There are sustainability influencers who are working on issues like climate change, social equity, pollution, and sustainable business and economic development all over the world. They are taking leadership positions in governments, in their communities, and in the business and non-profit world. They are helping to transform the world in important ways. This book tells their story and the story of the places where they work.

The book is divided into four distinct parts. Part I highlights issues associated with environmental sustainability, Part II focuses on equity and sustainability, Part III centers on economic themes and sustainability, and Part IV brings together a cluster of case studies on regions and cities. Each chapter contains background information on the topic and a case study. The chapters also include information about lessons learned and challenges and barriers that were identified that limit sustainability. Most chapters also contain a set of readings along with a list of references. While the sections were designed within the context of the three pillars of sustainability with an additional section for regional examples, the reality is that many of the chapters could fit in more than one section. Sustainability is by definition a holistic science. There are connections that can be made throughout the book across chapters and across sections. It is these connections that make sustainability such a dynamic and important topic of inquiry today.

References

Dale, Ann, and Lenore Newman. 2005. Sustainable Development, Education and Literacy. *International Journal of Sustainability in Higher Education* 6 (4): 351–362.

Johnston, Paul, Mark Everard, David Santillo, and Karl-Henrick Robert. 2007. Reclaiming the Definition of Sustainability. *Environmental Science and Pollution Research* 14 (1): 60–66.

Kates, Robert, Thomas M. Parris, and Anthony A. Leiserowitz. 2005. What Is Sustainable Development? *Environment* 47 (3): 8–21.

Merriam-Webster. n.d. Definition of Sustainability. https://www.merriam-webster.com/dictionary/sustainability

Moore, Julia E., Alekhya Mascarenhas, and Sharon E. Straus. 2017. Developing a Comprehensive Definition of Sustainability. *Implementation Science* 12 (110): 1–8.

Pope, Jenny, Alan Bond, Jean Huge, and Angus Morrison-Saunders. 2017. Reconceptualising Sustainability Assessment. *Environmental Impact Assessment Review* 62: 205–215.

Rockström, J., W. Steffen, K. Noone, Å. Persson, F.S. Chapin III, E. Lambin, T.M. Lenton, M. Scheffer, C. Folke, H. Schellnhuber, B. Nykvist, C.A. De Wit, T. Hughes, S. van der Leeuw, H. Rodhe, S. Sörlin, P.K. Snyder, R. Costanza, U. Svedin, M. Falkenmark, L. Karlberg, R.W. Corell, V.J. Fabry, J. Hansen, B. Walker, D. Liverman, K. Richardson, P. Crutzen, and J. Foley. 2009. Planetary Boundaries: Exploring the Safe Operating Space for Humanity. *Ecology and Society* 14 (2): 32. http://www.ecologyandsociety.org/vol14/iss2/art32/.

Sala, Serenella, Biagio Ciuffo, and Peter Nijkamp. 2015. A Systemic Framework for Sustainability Assessment. *Ecological Economics* 119: 314–325.

Steffen et al. 2015. Planetary Boundaries: Guiding Human Development on a Changing Planet. *Science* 347 (6223): 171–180.

Sustainable Development Solutions Network. 2017a. *SDG Index and Dashboard Report 2017*. http://www.sdgindex.org/assets/files/2017/2017-SDG-Index-and-Dashboards-Report--full.pdf.

———. 2017b. *The U.S. Cities Sustainable Development Goals Index 2017*. http://unsdsn.org/wp-content/uploads/2017/08/US-Cities-SDG-Index-2017.pdf.

United Nations. 1972. *Report of the United Nations Conference on the Human Environment*. http://www.un-documents.net/aconf48-14r1.pdf.

———. 1987. *Report of the World Commission on Environment and Development: Our Common Future*. http://www.un-documents.net/our-common-future.pdf.

———. 1992. *Declaration of the United Nations Conference on the Human Environment (Stockholm Declaration) and the Rio Declaration on Environment and Development, 1992*. http://legal.un.org/avl/ha/dunche/dunche.html.

———. 1997. The Earth Summit +5, Programme for the Further Implementation of Agenda 21. http://www.un.org/esa/earthsummit/.

———. 2002. *Environment and Sustainable Development: Implementation of Agenda 21 and the Program for the Further Implementation of Agenda 21*, Outcome Document from the World Summit on Sustainable Development. http://www.un.org/ga/search/view_doc.asp?symbol=A/C.2/57/L.83&Lang=E.

———. 2012. *The Future We Want, Outcome Document*. http://www.un.org/ga/search/view_doc.asp?symbol=A/RES/66/288&Lang=E.

———. 2015. *The Millennium Development Goals Report* http://www.un.org/millenniumgoals/2015_MDG_Report/pdf/MDG%202015%20rev%20(July%201).pdf.

———. n.d. *Small Island Developing States*. https://sustainabledevelopment.un.org/topics/sids.

United Nations Environment Programme (UNEP). 2017. Frontiers 2017: Emerging Issues of Environmental Concern. https://www.unenvironment.org/resources/frontiers-2017-emerging-issues-environmental-concern.

United States Environmental Protection Agency (US EPA). n.d. Definition of Sustainability. https://www.epa.gov/sustainability/learn-about-sustainability#what.

Waters et al. 2016. The Anthropocene Is Functionally and Stratigraphically Distinct from the Holocene. *Science* 351: 6269.

Part I

Environment

While all topics of sustainability are intertwined, there are some key themes that can be clustered together. In this first section, several topics related to environmental sustainability are reviewed. Geologists have noted that we have entered the Anthropocene, a time of widespread geologic change, as a result of human activity. The changes are so pronounced that they not only can be seen in the geological record but also in satellite images from space. The dramatic changes in the Aral Sea, in the Mississippi Delta region, and in ice coverage in alpine and polar regions are only a few examples of the evidence. We are in a time of environmental instability that has been brought about by human activity.

The following chapters review several situations around the world where environmental sustainability is challenging. This section highlights some of the most pressing issues that communities are confronting in this time of environmental change—from air pollution in China to waste management in the Middle East. Of course, each of these chapters highlights the challenges in a particular region. All corners of the world can find something to learn from the examples presented. For example, the water sustainability challenges in Southern California are similar to those seen in places like Israel, Spain, Australia, and Mexico. We have much we can learn from each other.

When considering that sustainability tries to address comprehensive issues that impact our lives, the authors of the chapters take unique approaches in their work that reflect the holistic nature of sustainability.

2

Sustainability and Natural Landscape Stewardship: A US Conservation Case Study

Johanna Kovarik

The terms "natural" and "landscape" encompass a wide range of interpretations and definitions, particularly when discussed in the larger conversation of environmental sustainability. Key issues center on the complexity and lack of consistency in geographic, biologic, or temporal boundaries and scales for what defines a particular community or ecosystem condition, and the dynamics of the presence and influence (or lack thereof) of humans (Schrader-Frechette and McCoy 1995; Landres et al. 1998). This evolving exchange about "what is natural" illustrates the changing cognizance of human society on the purpose, need, scale, and methodology for maintaining the intactness of ecosystems. In the long term, this changing perspective is documented in law and policy worldwide related to the environment. The roots of sustainability can be traced back to early forestry, and the ideals and policies of the United States (US) Forest Service in particular provide a case study for examining the coalescence of the domains of sustainability into the agency's mission today, "to sustain the health, diversity, and productivity of the Nation's forests and grasslands to meet the needs of present and future generations." The history of environmental policies of the US government in the setting of the larger environmental movement ultimately reflects humanity's struggle toward an ecological conscience.

J. Kovarik (✉)
University of South Florida, Tampa, FL, USA

R. Brinkmann, S. J. Garren (eds.), *The Palgrave Handbook of Sustainability*,
https://doi.org/10.1007/978-3-319-71389-2_2

Background

The term "natural landscape" is most commonly used in the literature to describe areas without existing human modification or impacts, or identifying the condition of an area during a time period when all components of a system were in equilibrium (Schoonmaker and Foster 1991; Fairweather and Swaffield 1999). The term "natural" implies a baseline condition of an ecosystem; however attempting to quantify or describe that baseline condition is a shifting target which depends heavily on the temporal and geographic scale selected, what is considered an existing human impact, and whether human impacts are part of the natural system. This already complex task becomes much more problematic when attempting to integrate the role of outlier or catastrophic events, or across deep time due to the lack and uncertainty of data (Landres et al. 1999). The term "landscape" brings humans into the equation more readily and gives definition to what is meant by an "area," the most basic definition simply meaning, "the appearance of the land," which frames landscapes in the context of what humans can see at certain scales (Brabyn 2009). This is expanded to include a concept of regional or kilometer-wide scale that is "a mix of local ecosystem or land use types…repeated over the land forming a landscape" "where humans interact with their environment" (Wiens and Milne 1989; Forman 1995). The concept of a landscape is most often used in landscape ecology studies involving spatial analysis and remote sensing, as well as natural resource management. Pulling these ideas together, at its most basic, a natural landscape is a non-impacted or unmodified mix of ecosystem types at a human-identified regional scale, with non-impacted or modified referring to human influences.

Due to the human element implicit in the idea of landscapes, cultural lenses and social values shape the definition of natural landscapes in terms of what is considered natural or what unmodified means. Leading up to today, luminaries such as Alexander von Humboldt, Charles Lyell, and Mary Somerville noted human alterations of the landscape and subsequent changes in their local ecosystems in the nineteenth century. Lyell's and others' early writings suggest the thought that actions of man could never equal the staying power of those of nature—that is, man's actions on the environment could be easily erased by the actions of nature (Goudie 2013). Europeans developed a religious or "Cornucopian" understanding of the natural landscape specifically in regard to the New World as an Eden with infinite resources which humans could not permanently alter (Glacken

1967; Worster 1993, Andrews 2006). Through the development of the concept of progress they eventually enshrined the values of industrialization, economic growth, and material production (Worster 1993; Du Pisani 2006). As the agricultural revolution led into the industrial revolution and the Americas were settled, the development of fossils fuels and mass production resulted in global problems such as acid rain and increases of greenhouse gases in the atmosphere. As science led industry, it also developed humanity's understanding of the linkages between natural systems. Based on this knowledge and through the growing awareness of environmental degradation's negative impacts on human life, researchers' viewpoints in relation to the concept of natural changed toward the end of the nineteenth and through the twentieth centuries. Concerns relating to overpopulation and scarcity of natural resources grew. Awareness developed of humanity as part of the larger organism of nature, of existing in community with the land and all its components. This awareness has culminated in today's concepts of the Anthropocene, global sustainability, and sustainable development (Brundtland 1987; Ruddiman 2013; Lewis and Maslin 2015).

A major purpose for arriving at a common definition of natural landscapes is the need for scientists and land managers to have a framework on which to base policies, objectives, and stewardship strategies for maintaining balance between ecosystem components. Humanity has advanced a modern definition of "natural landscapes" through our growing collective understanding of humankind as part of the larger natural community. However, maintaining natural landscapes now presents a difficulty for humanity as our capacity to effect change on the natural environment has grown. Our institutions for stewarding the land are broad in scope and diverse in mission, and these "… management systems are not geared for managing moving targets or coping with the uncertainty and surprise that are inherent and fundamental aspects of ecological systems" (Landres et al. 1999). The use of the term "sustainability" in relation to natural landscapes centers on the future resilience of the current systems and processes at work on earth, which support, or sustain, human life. In light of modern sustainability, a natural landscape is a resilient landscape where all components or relationships are in balance (Noss 1993; Landres et al. 1999; Ellis et al. 2010). Humans are a major component of that system, and natural landscapes are socio-ecological systems. Since the industrial revolution, however, we have been an imbalanced component of that system at all scales of study. Conservation is the pathway to that sustainability, leading to the further development of our ecological conscience and broadening our understanding of humanity's role as a member of natural landscapes.

Case Study: The Forest Service and the Evolution of Conservation in the United States

Early Conservation of Natural Landscapes in the United States

As the perception of natural landscapes is ever changing, so is the prevailing thought on stewardship of these landscapes. Conservation and a concern for sustainability of practices usually begins when a society notices that their key natural resources are dwindling and may give out within their immediate lifetime, or when environmental disasters are linked to resource degradation. Populations in the seventeenth century were expanding, and impacts from a high density of people were problematic in Europe and Asia. In the southern areas of North America through the 1300s, the cultures of the Maya and the Ancestral Pueblo mirrored this trend, and collapsed due to a variety of issues, which included dwindling natural resources like timber. In the areas that would become the United States and Canada, however, landscapes were natural, in the sense that the forces of nature were all in balance, including the impact of people. With the arrival of Europeans and the establishment of new countries in North America, the population boomed and the way of life of people living in North America changed drastically from the 1700s to the 1900s.

In the late 1700s and into the 1800s, the fledgling government in the United States gave away land and encouraged settlement. Forest loss across the continent increased dramatically as land was cleared for agriculture and timber was needed for settlements. New monetary systems and the need for farm products in the recently created country resulted in many across the United States transitioning from local small-proprietor economies to regional and global markets feeding the growth of the industry (Kulikoff 1989). The government of the United States supported citizen's rights to access and use their natural resources (a right previously restricted in the old world), as well as furthering technology through education. The manufacturing industry grew dramatically, supporting the rise of mining, which required high quantities of timber (David and Right 1997). Developments in railroads also allowed for a jump in commerce, and industry across the continent amassed empires based on lumber, coal, and minerals. However, at this same time, urban populations in the United States were also developing an appreciation for nature through recreation such as hunting, fishing, birding, and hiking.

Early threads of sustainability can be traced from ancient Mesopotamian civilizations to Greek and Roman times in reaction to increases in population density, pollution, forest reduction, environmental disasters, and loss of farmland (Glacken 1967; Du Pisani 2006; Hornborg 2007). In particular, timber has long been a resource of first concern for civilizations, as it provides for or supports the most basic of human needs including shelter, food, and warmth. In Europe during the seventeenth and eighteenth centuries, the concept of sustainable forestry, or providing for the benefit of future generations from forests, was introduced through the work of scientists in England, France, and Germany (Wiersum 1995). US scientists and writers in the 1800s had the benefit of learning from the European idea of forest sustainability, and called attention to the rapid depletion of forests across the country. They wrote articles and books with dire predictions of a total loss of viable timber by the early 1900s (Miller 1997). Building on the writings of Lyell, Humboldt, Somerville, and others, a seminal work by George Marsh in 1864 weaves together not only an awareness of the consequences of human disturbance of landscapes but also demonstrated the earliest look at the continuity of landscapes across a more regional and global scale. Through the developing awareness of these concepts, the loss of forests in the United States was linked to issues of water and health and aroused the interest of individuals and formal societies concerned with recreation related to big game animals and bird populations.

The forestry and conservation movement in the United States in the late 1800s gained momentum through the development and involvement of naturalist groups such as the Audubon and Boone and Crockett societies and the Sierra Club. Additionally, as travel across the continent became easier, artists and writers inspired by the natural grandeur created one of the earliest environmental marketing campaigns. Painting and writings by those associated with the Hudson River School and luminaries such as Henry David Thoreau and George Bird Grinnell captured the imagination of the urban populations' spurring support reflected in the US Congress. Based on these efforts the first national park, Yellowstone, was created out of the idea of "public lands for all" to enjoy for recreation, as opposed to lands controlled by a single wealthy party. The removal of this first national parkland created precedence for setting aside US forest reserves, the first of which were created in 1891.

Prussian Bernhard Fernow in 1896 brought the concepts of sustainable forestry with him from Europe as the chief of the US Division of Forestry, which was created to be in charge of the forest reserves. Fernow's book *Economics of Forestry* in 1902 built on the work of Marsh, defining different types of natural resources from the viewpoint of human use and impact. Fernow incorporated concepts of renewable vs. nonrenewable ecosystem

components, changes in those components related to human activities as well as natural variations, and the importance of scale of those resources in terms of distribution of a resource across a landscape. Fernow more fully established the ideal of sustained yield forestry that called for a tree-farming approach, where the same amount of timber would be available for harvest annually, into perpetuity (Fernow 1902). Forester Gifford Pinchot, who had been trained in Europe, reinforced these ideas with his work developing policy for the reserves on the Forestry Commission in 1896 and succeeding Fernow at the Division of Forestry in 1898 (Pinchot 1998). Finally, as president in 1905, Roosevelt established the formal US Forest Service out of the Division of Forestry, with Gifford Pinchot as the country's first chief forester through the Transfer Act. In 1911 and 1924 the new national forests were expanded to the Eastern United States through the Weeks and Clarke-McNary Acts, and the conservation movement was off and running.

The concerns of the early conservation movement were heavily economic and social, or political, demonstrating a preliminary foundation toward two of the domains necessary for long-term sustainability. References to natural landscapes in US law highlight this resource commodity-based focus, with the 1872 inscription of Yellowstone illustrating the government's desire to "[retain] in their natural condition"…"all timber, mineral deposits, natural curiosities, or wonders within said park" (Yellowstone National Park Protection Act 1872). After the establishment of the US Forest Service, the prevailing management direction was that these national forest landscapes were to be used but to be used wisely and the "public good comes first" (Pinchot 1998). The agency focused on allowing natural landscapes to be used on a smaller scale by the "small guy, or the homesteader" as opposed to being monopolized by larger corporations. Pinchot's thought behind this policy was to allow for social and economic sustainability, and resiliency of the United States in the long term. The 1897 Sundry Civil Appropriations Act (otherwise known as the Forest Service Organic Administration Act) highlights this focus, addressing concerns related to future unavailability of timber resources and environmental disasters such as flooding by mandating that the forest reservations "[secure] favorable conditions of water flows, and…furnish a continuous supply of timber."

Pinchot's conservation ethic and definition of natural landscapes reflected the predominant conservation movement of the times, that humans had a responsibility to control the use of the earth's natural resources for the benefit of humanity in the long term. Natural landscapes were thought of specifically of their components, natural resources, to be used by people, with all other considerations such as wildlife habitat as secondary (Pinchot 1998). However,

the view of people as omniscient caretakers of the environment and the cultural definition of a natural landscape began to change as the conservation movement evolved beyond its Progressive roots in the 1920s and 1930s. Awareness of the other domains integral to achieving sustainability began to develop during the latter part of the 1900s and was woven into the rhetoric of conservation. This included an understanding of ecology with humans as a component of the ecosystem and the expansion of the United States' environmental culture through incorporation of an "ecological conscience."

The US Forest Service: An Evolving Approach of Conservation and Sustainability

Putting the new conservation policy of the Forest Service into practice required balancing demands from pro-development groups and preservationist proponents. Detractors from the conservation movement believed that people were learning to wisely use resources without government guidance, and the conservation movement would limit US citizen's new personal liberties, while the preservationists felt that conservation did not go far enough to protect natural landscapes (Merchant 2005). Pinchot recognized early on that applying conservation on federal lands in isolation would not be successful in the long term, that true conservation required consideration of the larger landscape and broader economic issues. While the Forest Service favored federal regulation and eagerly worked to promote conservation ideas through technical assistance to state and private forests, industry and the western states were largely resistant to this idea. From the 1920s to the 1940s the agency's hope for regulation gradually gave way to a cooperative state and private forestry program in progress, cumulating in the 1944 Sustained Yield Act. While this act was largely a failure at attempting to create a certain type of cooperative forestry, it was the first Act that mentioned multiple uses of resources beyond timber in one piece of Forest Service legislation, setting the stage for future efforts.

While the Forest Service was working on implementing and learning the limits of their ability to manage forests, the ecological understanding of foresters and those working in and with land management agencies was growing. A small group of passionate individuals campaigned for designating areas of public lands where no developmental use was allowed, or lands that were preserved. National parks had continued to be created since Yellowstone, and the National Park Service was created in 1916 to be the custodian of these areas largely due to the efforts of John Muir (Frome 1997; Miller 1997).

Forest Service conservationists, however, felt that natural landscapes not open for development should be part of an overall mosaic of landscapes. While Pinchot mused in his autobiography that all agencies should perhaps be combined and work together for the conservation goal including elements of preservation, others disagreed with Pinchot's pro-use mantra that would allow for grazing and timber harvest in those areas selected to be primitive (Frome 1997; Pinchot 1998). A political battle for land between the National Park Service and the Forest Service set the conservation agency on the path of departing from Pinchot's insistence on development. Agency employees Arthur Carhart, Aldo Leopold, and Robert Marshall felt that the Forest Service was the best agency to incorporate preservation as part of a larger conservation ethic. Their work, along with residual tensions with the National Park Service, resulted in the agency establishing primitive and wilderness areas in the 1930s and 1940s. Leopold and Carhart developed some of the first definitions of natural landscapes for US land management including the idea that "undeveloped" areas were important in their current state without generating an economic product (Frome 1997). Leopold's writing in particular during the 1930s and 1940s was also the first to espouse a philosophy that recognized the importance of the ecological and cultural components of sustainability. This demonstrated a new awareness of stewarding natural landscapes for purposes beyond natural resource production or human enjoyment—the development of the science of ecosystem management (Leopold 1989; Callicott 2000). Leopold also expanded the definition of "natural" to include humanity, and signaled the first shift in consciousness from humans as separate caretakers of nature to being another integral component of the ecosystem. In his early writings he outlined that "…there is only one soil, one fauna, one people, and hence only one conservation problem…," and in his later works included Native Americans as part of the desert ecosystem (Leopold 1989, 1992).

Leopold and Marshall further developed ideas related to the geography and scale of ecological sustainability outside of timber issues, which the agency was already working on to address through its efforts with state and private forestry. Foresters and other managers in the past had written extensively about natural resources, while this new group began to describe natural resources in the context of landscapes, or as complete ecosystems. While programs existed for soil, water, and forest conservation on private lands, they were proving largely unsuccessful, and Leopold argued that this was due to lack of a culture of environmental ethics in the United States (Leopold 1989). In response to environmental issues in the 1920s and 1930s, soil, wildlife, and other ecosystem components were incorporated into management through

the Migratory Bird Conservation Act of 1920, Taylor Grazing Act of 1934, the Bankhead-Jones Farm Tenant Act of 1937, the Pittman-Robertson Act of 1937, and the creation of the Bureau of Land Management in 1946. At the end of this period, many of the components necessary for crafting natural landscape, or ecosystem sustainability in the long term, had been brought forward. The next decades would see the Forest Service strain to integrate these components in a manner that aligned with the "utilitarian conservation" mission of its inception, and then finally adapt to move beyond those roots.

A combination of factors related to the end of World War II and invasive species epidemics from 1940 to 1970 saw a dramatic increase in the number of trees harvested from national forests. The Forest Service, finally able to stretch its wings and put sustained yield principles into practice, cut massive areas of forest across the country in line with its mission of efficient use. In 1960, the Forest Service Multiple Use Sustained Yield Act worked to move away from the cooperative forestry experiments based on the 1940s Act and to ingrate disparate resource management Acts of the 1930s and 1940s. The 1960 Act was the first discrete management guidance for the agency elevating other natural resources to the same level as timber and water, which were specifically identified in the Organic Act of 1897. This Act also formalized the incorporation of undeveloped landscapes as part of national forest management and propagated sustained yield for all natural resources on agency lands. In the 1960s and 1970s, the agency continued to focus on ramping up its timber program to bring US forests into production by harvesting old growth stands.

At the same time, the ideas of Leopold and of the country's developing "ecological consciousness" continued with the dawning of a new environmental movement in the United States beginning in the 1960s, manifesting first in the Wilderness Act of 1964. The definition in the Act states that a wilderness "[is] an area where the earth and its community of life are untrammeled by man…appears to have been affected primarily by the forces of nature…has at least five thousand acres of land or is of sufficient size as to make practicable its preservation and use …" (Wilderness Act 1964). This Act presented the first in-depth legal definition of natural landscapes in the United States including the idea of the role of humans, the integrity of the ecosystem instead of discrete natural resources, and geographic scale. Founded in the work of agency conservationists such as Leopold in the 1940s came the growing recognition that economic and social sustainability are not achievable without ecological sustainability.

The path of the Forest Service, finally able to actively implement their program of sustained yield after 30 years, collided with the new ecological

cultural awakening in the United States. Academic foresters began to realize that this approach was not working out well in managed forests in Europe and criticized sustained yield (Behan 1978; Miller 1997). Science had moved beyond the agency's early guiding tenants and valued wilderness as a place to study the new ecosystem concept. Following World War II, an increase in economic prosperity and population was matched by an increase in recreational visits to public lands and wilderness, spreading interest, appreciation, and understanding in the country's natural resources—growing the national ecological consciousness through the 1950s and 1960s. This educated and invested population began to see what they viewed as detrimental changes in those landscapes in which they recreated and studied, and found a new voice—which they used to decry the large-scale forestry operations on national forests. The change in cultural and ecological thinking had moved in a different direction than the domains of politics and economics. However, with public pressure, the way US public lands were managed began to change through a slew of environmental acts attempting to incorporate these new ideals. These Acts included the National Environmental Policy Act of 1970, the Forest and Rangeland Renewable Resources Planning Act of 1974, the National Forest Management Act of 1976, and the Federal Land Policy and Management Act of 1976. All of these pieces of legislation worked to improve upon multiple-use planning, to integrate multi-disciplinary thinking, and to reconcile the previous conservation ethics with the new ecological consciousness of the population. At this same time, the modern sustainability movement took shape globally, with the same general philosophy as the Forest Service but with a formal recognition that the consideration of many values is necessary to ensure its success. This included highlighting the need for connectivity between politics, economics, natural resource management, community, and culture when planning for future endeavors (Brundtland 1987).

The concept of natural resources in the United States had further transitioned in the public rhetoric to ecosystems and on to the larger "environment" concept, buoyed by the growing international movement. The National Environmental Policy Act solidified this new ethos, broadening the definition from the Wilderness Act to include concepts such as "harmony between man and his environment" and the biosphere (National Environmental Policy Act 1970). With the 1980s and the dawn of the 1990s, the idea of the use of natural resources and traditional conservation was seen in a negative light in the larger framework of the new environmentalism based on its implementation as sustained yield forestry. While the concept of conservation and multiple use remained at the Forest Service's core, the agency worked to reconcile its

policies with the need to integrate other uses, resources, economic, and social issues. The agency's first major shift in this progression was to develop the concept of ecosystem management in 1993, highlighting sustainable ecosystems as a goal.

With ecosystem management, the Forest Service firmly established in its policy the concept that humans are part of the ecosystem and extended the multiple resource management approach to recognize that ecosystems cross political boundaries. Additionally, this method incorporated recognition of the capacity for ecosystems to change over time including large-scale short-term events. Through increased public participation, the agency sought to bring forward a more collaborative approach to the environmentalist and scientific community who had largely lost faith in the political institution to manage natural resources during the 1970s and 1980s (Lee 1994; Dubay et al. 2013). During the 1990s the United States and global communities moved toward sustainable management through a variety of initiatives. In 1993, the president of the United States mandated sustainable management of forests, and in 1995 the United States joined with 12 other nations in the Montreal Process to create indicators as guideposts for forest sustainability. Forest landscape restoration became a priority along with a new concept, "resiliency" of ecosystems. Overall ecosystem management was viewed as a success by the agency; however other researchers felt the Forest Service's approach lacked cohesion and ignored other important management issues (Sedjo 2000; Butler and Koontz 2005). In order to guide this broad process and to truly achieve sustainability across the emerging range of ecological, social, and economic goals, agency-wide strategic plans were and are developed. The current strategic plan of the agency for 2015–2020 has a top goal of "Sustaining Our Nation's Forests and Grasslands." This includes a main objective to "Foster resilient, adaptive ecosystems to mitigate climate change." (USDA 2015). Continued emphasis on ecological restoration is valued in the light of continuing to ensure that ecosystem services are delivered and that their resiliency is ensured in the light of climate change (USDA 2015). The Forest Service's review of the Montreal Process Criteria and Indicators in 2010 contains an important section, "Sustainability Across Landscapes and Through Time" (USDA 2011). Forests, and natural landscapes overall, must be incorporated into an "all lands" approach to sustainability. Natural landscapes truly cannot be separated from other types of landscapes but, like humans, are parts of the larger ecosystem.

Lessons Learned and Future Challenges

This case study serves to demonstrate how the United States has evolved in the last 200 years of understanding of the environment and how adaptive and collaborative management has changed as a result. This brief overview of the evolution of the concept of natural landscapes and sustainable land stewardship in the United States demonstrates the adaptive and multifaceted process of achieving sustainability. There has been much research on this topic and a wealth of writing offers a deeper look at the many components integral to this case study, which could only be superficially addressed here. However, it also serves to show that many of the issues we face today are the same as those faced at the inception of the Forest Service in the early part of the last century. Indeed, it has been well recognized that the "problem of creating a productive relationship with our surroundings is as old as civilization itself" (Lee 1994). This chapter presents but a brief window into the most recent work of sustainability in the context of land stewardship.

The history of land stewardship in the United States and that of the Forest Service allows us to see a new country test the limits of development. We have learned through failures and successes that balancing the needs of society and the environment is really not a balancing act, but the slow integration of those purposes on our journey of sustainability (MacCleery et al. 2004). One of the challenges that the global community faces today is a larger problem already addressed at the smaller scale, that of integrating conservation and sustainable principles across geographic and political boundaries to realize a larger vision of sustainability. Marsh also reflected in 1864 that the ultimate challenge to achieve this was overcoming ignorance and greed—Leopold's thoughts echoed humanity's need to develop an "ecological conscience." This challenge is all the more difficult in today's global society and changing climate, where threats from invasive species, wildlife, and other natural disasters are increasing in frequency. The Forest Service is working to address this issue through a deeper understanding of the concept of social acceptability. This involves incorporating science-based methodologies for learning about and integrating people's attitudes, beliefs, and values into land stewardship (Allen et al. 2009). Through understanding a wide range of stakeholders and their interrelation dynamics, the Forest Service and our global society as a whole can work to create an environment of mutual learning and collaboration to better steward the land.

Further Reading

Allen, S.D., D.A. Wickwar, F.P. Clark, R.R. Dow, and R. Potts. 2009. *Values, Beliefs, and Attitudes Technical Guide for Forest Service Land and Resource Management, Planning, and Decision-Making*. Washington, DC: United States Department of Agriculture Forest Service.

Allen, Craig R., Joseph J. Fontaine, Kevin L. Pope, and Ahjond S. Garmestani. 2011. Adaptive Management for a Turbulent Future. *Journal of Environmental Management* 92 (5): 1339–1345.

Andrews, Richard N. 2006. *Managing the Environment, Managing Ourselves: A History of American Environmental Policy*. New Haven: Yale University Press.

Behan, R.W. 1978. Political Popularity and Conceptual Nonsense: The Strange Case of Sustained Yield Forestry. *Environmental Law 8*: 309–342.

Brabyn, Lars. 2009. Classifying Landscape Character. *Landscape Research* 34 (3): 299–321.

Brundtland, Gro Harlem. 1987. World Commission on Environment and Development: Our Common Future. *World Commission for Environment and Development.* New York: Oxford University Press.

Butler, Kelly F., and Tomas M. Koontz. 2005. Theory into Practice: Implementing Ecosystem Management Objectives in the USDA Forest Service. *Environmental Management* 35 (2): 138–150.

Callicott, J. Baird. 2000. Harmony Between Men and Land—Aldo Leopold and the Foundations of Ecosystem Management. *Journal of Forestry* 98 (5): 4–13.

Chazdon, Robin L., Pedro H.S. Brancalion, Lars Laestadius, Aoife Bennett-Curry, Kathleen Buckingham, Chetan Kumar, Julian Moll-Rocek, Ima Célia Guimaraes Vieira, and Sarah Jane Wilson. 2016. When Is a Forest a Forest? Forest Concepts and Definitions in the Era of Forest and Landscape Restoration. *Ambio* 45 (5): 538–550.

Cole, David N., Laurie Yung, Erika S. Zavaleta, Gregory H. Aplet, F. Stuart III Chaplin, David M. Graber, Eric S. Higgs, et al. 2008. Naturalness and Beyond: Protected Area Stewardship in an Era of Global Environmental Change. *The George Wright Forum* 25: 36–56.

David, A. Paul, and Gavin Wright. 1997. Increasing Returns and the Genesis of American Resource Abundance. *Industrial and Corporate Change* 6 (2): 203–245.

Du Pisani, Jacobus A. 2006. Sustainable Development–Historical Roots of the Concept. *Environmental Sciences* 3 (2): 83–96.

Dubay, Tayloe, Dave Egan, Evan E. Hjerpe, Wendy Selig, Dave Brewer, Dana Coelho, Zachary Wurtzebach, Courtney Schultz, and Amy EM Waltz. 2013. *Breaking Barriers, Building Bridges: Collaborative Forest Landscape Restoration Handbook*. Flagstaff: Northern Arizona University Ecological Restoration Institute.

Ellis, Erle C., Kees Klein Goldewijk, Stefan Siebert, Deborah Lightman, and Navin Ramankutty. 2010. Anthropogenic Transformation of the Biomes, 1700 to 2000. *Global Ecology and Biogeography* 19 (5): 589–606.

Fairweather, John R., and Simon R. Swaffield. 1999. *Public Perceptions of Natural and Modified Landscapes of the Coromandel Peninsula, New Zealand*. Lincoln: Agribusiness and Economics Research Unit, Lincoln University.

Fernow, Bernhard E. 1902. *Economics of Forestry: A Reference Book for Students of Political Economy and Professional and Lay Students of Forestry*. New York: Crowell.

Forest Ecosystem Management Assessment Team. 1993. *Forest Ecosystem Management: An Ecological, Economic, and Social Assessment: Report of the Forest Ecosystem Management Assessment Team*. Washington DC.

Forman, Richard T.T. 1995. Some General Principles of Landscape and Regional Ecology. *Landscapeecology* 10 (3): 133–142.

Frome, Michael. 1997. *Battle for the Wilderness*. Salt Lake City: University of Utah Press.

Glacken, Clarence J. 1967. *Traces on the Rhodian Shore: Nature and Culture in Western Thought from Ancient Times to the End of the Eighteenth Century*. Berkeley: University of California Press.

Goudie, Andrew S. 2013. *The Human Impact on the Natural Environment: Past, Present, and Future*. Chichester: John Wiley & Sons.

Hahn, W. Andreas, and Thomas Knoke. 2010. Sustainable Development and Sustainable Forestry: Analogies, Differences, and the Role of Flexibility. *European Journal of Forest Research* 129 (5): 787–801.

Hornborg, Alf, John Robert McNeill, and Juan Martínez Alier. 2007. *Rethinking Environmental History: World-System History and Global Environmental Change*. Lanham: Rowman Altamira.

Huffman, James L. 1978. A History of Forest Policy in the United States. *Environmental Law* 8 (2): 239–280.

Jorling, Thomas C. 1976. Incorporating Ecological Principles into Public Policy. *Environmental Policy and Law* 2 (3): 140–146.

Kulikoff, Allan. 1989. The Transition to Capitalism in Rural America. *The William and Mary Quarterly: A Magazine of Early American History* 46: 120–144.

Landres, Peter B., Peter S. White, Greg Aplet, and Anne Zimmermann. 1998. Naturalness and Natural Variability: Definitions, Concepts, and Strategies for Wilderness Management. In *Wilderness and Natural Areas in Eastern North America*, 41–52. Nacogdoches: Center for Applied Studies in Forestry, Stephen F. Austin State University.

Landres, Peter B., Penelope Morgan, and Frederick J. Swanson. 1999. Overview of the Use of Natural Variability Concepts in Managing Ecological Systems. *Ecological Applications* 9 (4): 1179–1188.

Lee, Robert G. 1994. *Broken Trust, Broken Land: Freeing Ourselves from the War Over the Environment*. Wilsonville: Bookpartners.

Leopold, Aldo. 1989. *A Sand County Almanac, and Sketches Here and There.* Outdoor Essays & Reflections. New York: Oxford University Press.

———. 1992. *The River of the Mother of God: And Other Essays by Aldo Leopold*. Madison: University of Wisconsin Press.

Lewis, S.L., and M.A. Maslin. 2015. Defining the Anthropocene. *Nature* 519 (7542): 171–180.

Maccleery, Douglas W., John Fedkiw, and Alaric V. Sample. 2004. *Pathway to Sustainability: Defining the Bounds on Forest Management*. Durham: The Forest History Society.

Merchant, Carolyn, ed. 2005. *Major Problems in American Environmental History: Documents and Essays*. Belmont: Wadsworth Publishing Company.

Miller, Char. 1997. *American Forests: Nature, Culture, and Politics (Development of Western Resources)*. Lawrence: University Press of Kansas.

Multiple Use Sustained Yield Act of 1960, 86-517, 74 Stat. 215.

National Park Service Organic Act of 1916, 64-, 39 Stat. 535.

Newbold, Tim, Lawrence N. Hudson, Andrew P. Arnell, Sara Contu, Adriana De Palma, Simon Ferrier, Samantha L.L. Hill, et al. 2016. Has Land Use Pushed Terrestrial Biodiversity Beyond the Planetary Boundary? A Global Assessment. *Science* 353 (6296): 288–291.

Noss, Reed F. 1991. Sustainability and Wilderness. *Conservation Biology* 5 (1): 120–122.

———. 1993. Some Principles of Conservation Biology, as they Apply to Environmental Law. *Chicago-Kent Law Review* 69: 893.

Palka, Eugene J. 1995. Coming to Grips with the Concept of Landscape. *Landscape Journal* 14 (1): 63–73.

Pinchot, G. 1998. *Breaking New Ground*. Washington DC: Island Press.

Ruddiman, William F. 2013. The Anthropocene. *Annual Review of Earth and Planetary Sciences* 41: 45–68.

Samson, F.B., and F.L. Knopf. 2013. *Ecosystem Management: Selected Readings*. New York: Spring Science & Business Media.

Schmithüsen, F. 2013. Three Hundred Years of Applied Sustainability in Forestry. *Unasylva* 64 (240): 3–11.

Schoonmaker, Peter K., and David R. Foster. 1991. Some Implications of Paleoecology for Contemporary Ecology. *The Botanical Review* 57 (3): 204–245.

Sedjo, R.A. 2000. *A Vision for the US Forest Service: Goals for Its Next Century*. Washington, D.C.: Resources for the Future.

Shrader-Frechette, Kristin S., and Earl D. McCoy. 1995. Natural Landscapes, Natural Communities, and Natural Ecosystems. *Forest & Conservation History* 39 (3): 138–142.

Steen, Harold K. 2013. *The US Forest Service: A Centennial History*. Washington, DC: University of Washington Press.

Steffen, Will, Åsa Persson, Lisa Deutsch, Jan Zalasiewicz, Mark Williams, Katherine Richardson, Carole Crumley, et al. 2011. The Anthropocene: From Global Change to Planetary Stewardship. *AMBIO: A Journal of the Human Environment* 40 (7): 739–761.

Sundry Civil Appropriations Act of 1897 (Organic Act of 1897), 55-1, 30 Stat. 34-36.

The National Environmental Policy Act of 1970, 91-190, 83 Stat. 852.
The Sustained Yield Forest Management Act of 1944, 78-273, 58 Stat. 132.
Thomas, Jack Ward. 1996. Forest Service Perspective on Ecosystem Management. *Ecological Applications* 6 (3): 703–705.
Transfer Act of 1905, 59- , 33 Stat. 628.
U.S. Forest Service Centennial Congress, and S. Anderson. 2006. *Proceedings of the U.S. Forest Service Centennial Congress: A Collective Commitment to Conservation: January 3–6, 2005*. Durham: Forest History Society.
USDA Forest Service. 2011. *National Report on Sustainable Forests—2010 United States Department of Agriculture.* Washington DC.
———. 2015. *USDA Forest Service Strategic Plan: FY 2015–2020*. Washington DC.
Wiens, John A., and Bruce T. Milne. 1989. Scaling of 'Landscapes' in Landscape Ecology, or, Landscape Ecology from a Beetle's Perspective. *Landscape Ecology* 3 (2): 87–96.
Wiersum, K. Freerk. 1995. 200 Years of Sustainability in Forestry: Lessons from History. *Environmental Management* 19 (3): 321–329.
Wilderness Act of 1964, 88-577, 78 Stat. 890.
Williams, G.W. 2005. *The USDA Forest Service: The First Century*. Washington, DC: USDA Forest Service.
Worster, D. 1993. *The Wealth of Nature: Environmental History and the Ecological Imagination*. New York: Oxford University Press.

3

Policy Design for Sustainability at Multiple Scales: The Case of Transboundary Haze Pollution in Southeast Asia

Ishani Mukherjee

Background

Transboundary pollution presents a critical policy problem due to the tripartite nature of its inherent ecological, health, and political risks. The ways in which this policy problem has unfolded in the Southeast Asian region makes it an issue that traverses multiple policy jurisdictions: (1) as a *local* dilemma due to the immediate environmental implications to neighboring states, (2) as a *regional* quandary with diffuse and often inconsistent priority that is given toward its governance, and (3) as a *global* policy issue that can undermine international climate change mitigation efforts.

Transboundary pollution can take many forms. It mainly results from human-driven activities such as the upstream construction of a dam leading to sedimentation of rivers and other water sources in downstream nations (McCaffrey 2015), or the leaching of hazardous industrial wastes into water sources that are pertinent to multiple bordering jurisdictions (Shortle et al. 1998). One type of transboundary pollution that has been witnessed repeatedly by members of Association of South East Asian Nations (ASEAN) region is smoke pollution from fires caused due to unsustainable land-clearing practices in one nation severely deteriorating the air quality of adjoining countries.

Locally, the environmental and economic repercussions of chronic forest fires in Indonesia have been devastating. The World Bank has estimated that

I. Mukherjee (✉)
Institute of Water Policy, Lee Kuan Yew School of Public Policy, National University of Singapore, Singapore, Singapore

R. Brinkmann, S. J. Garren (eds.), *The Palgrave Handbook of Sustainability*,
https://doi.org/10.1007/978-3-319-71389-2_3

the fires of 2015 cost Indonesia USD 16.1 billion in damages due to its detrimental effects on health and agriculture, forestry, trade, tourism, and transportation sectors. These costs do not reflect the greater impacts of sustained exposure to haze to long-term health, nor do they include the detrimental losses to ecosystem services (World Bank 2016). In neighboring states, such as Singapore, the task of devising robust policy solutions has become even more pertinent as domestic water use and energy demand have been shown spike as a way to deal with episodes of haze that—although they may occur at predictable times of the year—are happening with increasingly unpredictable and often unprecedented intensities. News authorities in Singapore have reported water and power consumption levels reaching record highs during the most intense periods of haze over the last few years.[1] Understandably, the air pollution caused by the haze can have a notable impact on society's use of water and other utilities as activities become periodically concentrated indoors causing the heightened use of cooling and filtration equipment. This trend is indicative of the compromising effect of the haze on the sustainable use of domestic water and energy supply that can in turn, take away from and at times undo parallel policy efforts for water and energy demand management and resilience.

As a response to the haze crisis, the design of the Singapore Transboundary Haze Pollution Act (THPA) represents a first-of-its-kind individual country policy response in Asia for governing pollution emanating from sources outside of its jurisdiction. Customized to address the management of haze impacts on local environmental contexts, it is a policy package that at present is centered on using indicators such as the air quality index to govern the magnitude of the state's response to haze events. However, as a novel policy platform, it also presents a distinct opportunity to address and strengthen the state's energy and water resilience policy targets, a distinction that makes the formulation and implementation design of the THPA a promising case research on sustainability policy design.

Regionally, all member states of the ASEAN have had to respond critically to manage and mitigate the effects of the haze within their own borders. Region-wide agreements between ASEAN member states as well as bilateral policies between Indonesia and its neighbors have been formulated over two decades. In order to create a united, institutional foundation for regional cooperation, formulating policies that deal with effects from pollution and emissions originating from outside of state jurisdictions has been a significant regulatory priority over the last few years as these episodes of fires, from Indonesia, have become more and more frequent (Nurhidayah et al. 2015;

Quah and Varkkey 2013; Forsyth 2014; Quah 2002; Tacconi et al. 2008; Heil and Goldammer 2001).

Risks from widespread forest fires include not only the local and regional damage to terrestrial and aquatic ecosystems but also have global climate implications from greenhouse gas emissions and the destruction of peatlands that represent rich carbon sinks (Lee et al. 2016). According to the World Resources Institute, the forest fires in Indonesia in the first half of 2015 alone have emitted an estimated 20 times more carbon than that of the United States.[2] Furthermore, avoiding episodes of deforestation presents the single most promising near-term, low-cost opportunity to reduce emissions from the region (ADB 2015).

Therefore, the responses to the haze and Indonesian forest fires present a unique case of sustainability policy that has necessitated overcoming individual state jurisdictional boundaries to address a regional and indeed, global policy priority.

Case Study

Sound policy formulation or policy design on the part of governments is about articulating policy aims and linking them with the policy means or instruments to achieve them. Successful outcomes from this endeavor for the purposive design of policy responses emerge when these instrument-goal interactions are optimized. This task is particularly pertinent in complex policy contexts such as those that unite concerns for deforestation, especially that which results from burning vegetation, to considerations for climate change mitigation. The involvement of multiple jurisdictions to tackle the multilayered problems of environmental sustainability complicates the task of enabling policy synergies that maximize policy complementarities while minimizing contradictions. In this light, it is the combination of policy instruments, rather than single policy tools, that are expected to achieve multifarious policy goals for sound sustainability policy design.

Transboundary haze in Southeast Asia from forest fires and the associated regional and global repercussion of large-scale deforestation presents an important case warranting policy design thinking. It is a problem that, although originates mostly in Indonesia, has grave and immediate repercussions in surrounding economies such as Singapore and other members of the ASEAN, and medium- to long-term impacts on global climate change mitigation efforts. However, the impact and policy aspirations at these three scales

surrounding deforestation and transboundary pollution have seldom been thought of together. And in presenting these multiple policymaking layers, this case argues that they need to be considered together in order to enhance sustainability and the long-term success for policy initiatives. In order to present the multidimensional sustainability implications of the issue and the policy responses to date, the case is organized as follows: Part 1 outlines the local environmental and social effects of fire-led deforestation in Indonesia. Part 2 deals with the transboundary consequences of the haze in neighboring states of the ASEAN caused due to slash-and-burn deforestation. Part 3 explores the salience of the case to global climate change mitigation.

Part 1: Local Realities—The Cost of Fire-Led Deforestation and Haze in Indonesia

More than 100,000 fires were recorded over approximately 2.6 million hectares of land in Indonesia between June and October 2015 that represented the worst forest fire crisis in the nation's history (World Bank 2016), much greater than the prolonged and severe forest fires of 1997–1998 that had galvanized regional policymaking efforts for mitigation in the ASEAN.

Despite its detrimental environmental and social impact, man-made burning of vegetation remains the popular mode of land clearing in Indonesia, due to its relative cost-effectiveness than more capital-intensive measures involving heavy machinery. Fire is considered the most convenient means to clear land by those engaged in large-scale industrial agriculture as well as medium- and small-scale farming (Siegert et al. 2001). Without adequate controls in place to contain this activity, burning of forests and peatlands in the region can quickly escalate and become detrimental to air quality due to the unmitigated emissions of smoke, hazardous gases, and aerosols (Lee et al. 2016; Reddington et al. 2014).

With weakly regulated or absent mechanisms of monitoring burning and weak law enforcement, episodes of widespread fire and haze have cost Indonesia substantially over the past several decades. The economic cost to Indonesia of fires and haze in 1997–1998 amounted to USD 9.3 billion, while the 2015 costs have surpassed USD 16 billion (BAPPENAS-ADB 1999; World Bank 2016) (Tables 3.1 and 3.2). This figure underestimates the costs from habitat loss and the negative impacts on ecosystem goods and services and of environmental degradation. As expressed by the World Bank (2016):

Table 3.1 Estimated economic losses due to 1997–1998 fires to Indonesia (USD million)

	Estimated costs		
Sector	Minimum	Maximum	Mean
Agriculture	2750	2750	2750
Forestry	5833	6658	6245
Health	145	145	145
Transmigration and Infrastructure	1	1	1
Transportation	18	49	33
Tourism	111	111	111
Firefighting	12	11	12
Total	8870	9726	9298

Source: BAPPENAS-ADB (1999)

Table 3.2 Estimated economic losses due to 2015 fires to Indonesia (US$ million)

	Estimated costs		
Sector	Minimum	Maximum	Total
Agriculture	173 (Papua)	1242 (C. Kalimantan)	4839
Forestry	92 (C. Kalimantan)	972 (S. Sumatra)	3931
Health	1 (Papua)	36 (Jambi)	151
Manufacturing and Mining	14 (C. Kalimantan)	183 (Riau)	610
Transportation	13 (Papua)	111 (C Kalimantan)	372
Tourism	4 (Papua)	118 (S. Sumatra)	399
Firefighting	11 (Riau)	49 (S. Sumatra)	197
Education	3 (Papua)	9 (S. Sumatra)	39
Trade	68 (Papua)	292 (Riau)	1333
Biodiversity Loss	17 (Jambi)	72 (S. Sumatra)	287
Carbon Emissions	204 (Riau)	1205 (S. Sumatra)	3966
Total	8870	9726	9298

Source: World Bank (2016)

> *The full impact of Indonesia's systemic fire and haze on flora and fauna is unknown. Fire destroys natural genetic variability, which helps species adapt resistance to parasites and infectious diseases. Burning biomass produces the precursors of ground-level (tropospheric) ozone (O3), which impacts plant growth and photosynthesis and leads to long-term effects on ecosystem structure and function. O3 has been shown to reduce yields of major food crops and to affect the nutritional quality of wheat, rice and soybean. It can also reduce the capacity of land to act as a carbon sink. The particulate matter in haze has also been shown to reduce local rainfall, which could, in turn, impact recently planted crops.*

Furthermore, peatlands within the forest landscapes of Indonesia are vulnerable to fires. Some of the largest carbon sinks in the world, peatlands, in Indonesia represent a significant fire hazard if they are drained to irrigate

agricultural plantations. Fires in peat swamps can persist below the ground level for months, releasing large amounts of noxious fumes, smoke, and carbon dioxide (Ramdani and Hino 2013).

Spatial mapping and associated estimates by organizations such as the World Resources Institute conclude that a strong link exists between these fires and concession areas that are owned by large agricultural corporations. Furthermore, lacking law enforcement, complex concession allocation systems, and unclear property rights have long undermined forestry governance in Indonesia (Glover and Jessup 2006).

Several positive policy initiatives by the Government of Indonesia (GOI) have emerged to address the haze and its associated consequences. However, these mark only the beginning of much more consolidated, robust, and inclusive measures that are necessary to uphold forest conservation. In 2009, former President Yudhoyono declared a national commitment to reduce Indonesia's greenhouse gas emissions to 26 percent by 2020 (41 percent with international assistance), compared to business as usual, and 87 percent of this goal is to be met by reducing emissions from deforestation and peat area conservation.[3] A major next step in conservation efforts came in May of 2011 when the GOI put in place a two-year moratorium on issuing new concessions that transform primary natural forests to plantation and logging parcels. This moratorium was extended for a further two years in May 2013. Further yet, in October 2015, President Joko Widodo called for a moratorium on new peatland concessions, henceforth pausing the transformation of peat swamps and forests into plantations (World Bank 2016).

Part 2: Regional Repercussions—Transboundary Haze in the ASEAN

The regional impacts of forest and peat burning events in Indonesia can occur at predictable times of the year, but their intensities can often be sporadic due to changing land use practices and variable weather patterns. Normal northerly wind patterns between June and October, the popular burning season in Indonesia, carry noxious gas and particulate matter through smoke across Indonesia and into Brunei, Malaysia, Singapore, and Thailand (Lee et al. 2016; Othman et al. 2014). This form of cross-border haze pollution can worsen through the irregular interactions with weather events such as the El Nino Southern Oscillation (ENSO), Indian Ocean Dipole and the Madden-Julian Oscillation (Lee et al. 2016; van der Werf et al. 2010). Such unanticipated

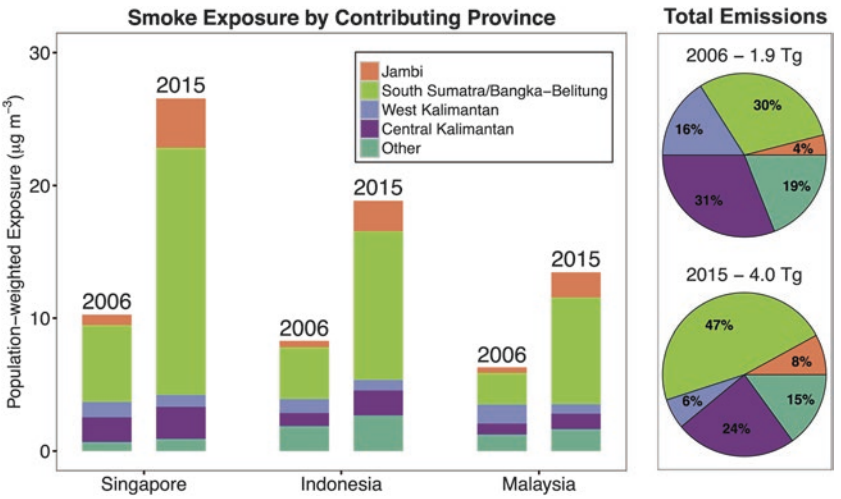


Fig. 3.1 Provincial contribution to transboundary haze in 2006 and 2015 (Source: Koplitz et al. 2016)

irregularities have caused some of the worst haze events in the region in 1997–1998, 2003, and, most recently, 2015 (Fig. 3.1).

Haze mitigation was raised to the formal governing agenda of the ASEAN and captured global attention after the 1997–1998 fires caused widespread smoke pollution and emitted an estimated 0.95 $GtCO_2e$ of carbon, representing almost 15 percent of average global emissions from fossil fuels (Page et al. 2002). Losses from the 1997–1998 haze in neighboring countries of Indonesia have been estimated to amount to USD 383 million, with the brunt felt strongest in Singapore (Glover and Jessup 2006). More recently, the Singapore Ministry of Environment and Water Resources has estimated that the 2015 haze cost the nation USD 700 million in economic losses.[4]

As transboundary haze has become a regular occurrence in the region, members of the ASEAN have deployed a variety of policy mechanisms to deal with the crisis (Mayer 2006; Elliott 2003). However, these have met with varying degrees of success in addressing and effectively mitigating the cross-border impacts of land clearing in Indonesia. Two major sets of policy responses to the haze have been formulated to date: the body of laws and agreements including the 2002 Agreement on Transboundary Haze Pollution (ATHP) by the ASEAN and the 2014 Singapore Transboundary Haze Pollution Act (THPA) (see Boxes 3.1 and 3.2).

Box 3.1 Singapore Transboundary Haze Pollution Act (THPA): Key Features (Lee et al. 2016)

Liability: There are criminal and civil liabilities for an entity that engages in conduct or condones another's conduct, which causes or contributes to haze pollution in Singapore. In addition, there is liability for an entity which participates in the management of a second entity (e.g., a subsidiary or a linked concern) if the latter engages in conduct or condones another's conduct which causes or contributes to haze pollution in Singapore.

Burden of proof and rebuttable presumptions: A series of rebuttable presumptions aim to overcome the burden of proof for the prosecution. First, companies will be presumed to own or occupy lands if there are maps showing that they own or occupy the lands in question. Second, if there is haze pollution in Singapore and there is, at or about the same time, a land or forest fire on any land situated outside Singapore, it will be presumed that the haze involves smoke from that land or forest fire if satellite, wind, and other meteorological information show that the smoke is moving in the direction of Singapore. This is so even if there may be other fires on other lands at or about the same time. Third, where the first and second presumptions are satisfied, it will be further presumed that the owner or occupier of the land in question has engaged in conduct, or engaged in conduct that condones any conduct by another, which caused or contributed to that haze pollution in Singapore. The burden is on the entity to disprove any of these presumptions.

Extraterritoriality: The Act claims to apply to any entity anywhere in the world whose conduct affects Singapore's air quality. It is based on extraterritorial environmental legislation found in other countries such as the United States. In practice, though, it is likely to be used against entities with a link to Singapore, for example, a Singapore subsidiary of an Indonesian plantation company (the subsidiary being incorporated and having a presence in Singapore, but owning or operating the land in question).

Fines: Up to SGD 100,000 (USD 79,900) for each day there is haze pollution in Singapore, capped at SGD two million. An additional fine of up to SGD 50,000 per day if the Singapore Director-General of Environmental Protection supplies a written request for fire-prevention activities (e.g., deploying firefighting personnel, discontinuing burning, or submitting an action plan), and this request is not acted upon. Entities can be liable for civil penalties, with no stated maximum penalty, if a plaintiff sustains personal injury or death attributable to the conduct of the entity that contributes to haze pollution. The Act was passed on 5 August 2014 and is available on this website: http://www.parliament.gov.sg/sites/default/files/Transboundary percent20Haze percent20Pollution percent20Bill percent2018-2014.pdf

Source: Adapted from Lee et al. (2016)

Box 3.2 ASEAN Agreements and Approaches to Transboundary Haze (Nurhadiyah et al. 2015)

The ASEAN addresses regional environmental problems like transboundary haze pollution through mostly prevention and cooperation measures rather than by establishing a liability regime or adopting formal legal instruments. This cooperative approach has resulted in an ASEAN preference for soft law over hard law.

Using soft law to address transboundary haze pollution has taken the form of declarations, resolutions, action plans, guidelines, and other policy initiatives. Significant soft laws include: the 1995 ASEAN Cooperation Plan on Transboundary Pollution; the 1997 ASEAN Regional Haze Action Plan; the 2003 ASEAN Zero Burning Policy; and the 2006 ASEAN Peatland Management Strategy. These laws have different focus areas. For example, the ASEAN Cooperation Plan addresses transboundary atmospheric pollution, transboundary ship-borne pollution, and transboundary movements of hazardous waste. Meanwhile, the Regional Haze Action Plan emphasizes national prevention, regional monitoring mechanisms, and mitigation and strengthened firefighting capability. The Zero Burning Policy promotes zero-burning techniques for plantation companies and timber concessionaries in the region, while the ASEAN Peatland Management Strategy guides the management of peatland.

Hard law has a role in the ASEAN regional legal framework, with the 2002 ASEAN Agreement on Transboundary Haze Pollution (AATHP) being the most significant haze pollution law. The UNEP Executive Director Klaus Toepfer stated that "with the Agreement, the region has a legal framework, as well as a comprehensive system of prevention and response against land and forest fires."

Although the AATHP entered into force in 2003, Indonesia only ratified it in 2014. Reasons for this delay included the perception that the Agreement encroached on its sovereignty and the lack of readiness and coordination of Indonesian government institutions in implementing the Agreement. For Indonesia, the cost of ratification and implementation outweighed the benefits gained, such as access to the ASEAN haze fund and other technical assistance. Ratification of the AATHP by Indonesia was a result of continuing pressure from Singapore and Malaysia for Indonesia to show the seriousness of its commitment in controlling land/forest fires. Hence, ratification of the AATHP evidenced Indonesia's good faith and intention to cooperate with its fellow ASEAN members.

Source: Adapted from Nurhidayah et al. (2015)

Part 3: Global Implications—Linking Deforestation in Southeast Asia and Climate Change

According to the Asian Development Bank (ADB) and the International Panel on Climate Change (IPCC), carbon dioxide emissions have grown by 330 percent over the past four decades. And from 1990–2010, emissions from Southeast Asia have ballooned at a rate of nearly 5 percent per year, growing more rapidly than any other region of the world. The Asia Pacific

region also comprises half of the top ten emitters of carbon dioxide in the world, including China, India, Japan, South Korea, and Indonesia. And more pertinently, Indonesia, Malaysia, the Philippines, Thailand, and Vietnam collectively comprise up to 90 percent of the emissions from Southeast Asia. Estimates from the Asian Development Bank (ADB) further indicate that in business-as-usual scenarios, the region is likely to incur larger economic costs from climate change than any other part of the world (ADB 2015).

With Southeast Asia poised as one of the most rapidly growing contributors of global emissions, deforestation and land use change have accounted for the majority of the regions carbon dioxide contribution. As revealed by data from the World Resources Institute, up to 55 percent of the regional greenhouse gas emission profile can be attributed to land use changes including agriculture and forestry.[5] Furthermore, the ADB concludes that most of these emissions directly stem from land degradation and deforestation in Indonesia, where these activities account for up to 70 percent of the country's emissions (ADB 2015). Further challenges arise when deforestation and land clearing involves the conversion of peatlands that serve as some of the deepest carbon sinks globally. Peat soils, as are found in Southeast Asia, can absorb carbon at the rate of 100 kg per hectare, yearly, constituting up to 33 percent of the Earth's terrestrial carbon sink (Fargione et al. 2008). Additionally, while much of the land that has been cleared has shifted to agriculture, some has also remained unclaimed after clearance.

The implications of this deforestation are profound for global climate cooperation. As is known, the 2015 Paris Climate Agreement aims to "hold the increase in the global average temperature to well below 2 degrees Celsius above pre-industrial levels and pursue efforts to limit the temperature increase to 1.5 degrees Celsius above pre-industrial levels, recognizing that this would significantly reduce the risks and impacts of climate change"[6] This policy directive has been a trigger for member nations of the United Nations Framework Convention on Climate Change (UNFCCC) Conference of Parties (COP) to align their financial flows in an effort to shift toward a low-carbon and climate resilient path to development (UNESCAP 2016). Currently, the Intended Nationally Determined Contributions (INDCs) of the parties to the Agreement indicate low-ambition commitments by Southeast Asian nations made at COP 21 at Paris (ADB 2015; UNESCAP 2016). The global average per capita emission targets for keeping on track with the Paris Agreement target of not exceeding a change of 2 degrees Celsius are between 6.7 and 6.8 tCO_2e (tons of carbon

dioxide equivalent), indicating that total emissions should not exceed 42 $GtCO_2e$ (Gigatons of carbon dioxide equivalent) in 2030. However, with current INDCs, the level of emissions is expected to be between 55.2 and 56.7 $GtCO_2e$ in 2030 (UNESCAP 2016).

Toward realizing the de-carbonizing goals of the UNFCCC COP-21, forest conservation and avoiding deforestation remain key policy strategies. In step with the targets identified in Paris for 2050, reducing deforestation remains the lowest-cost opportunity for mitigating emissions in the short to medium term (up to 2030) (ADB 2015). And the UNFCCC's policy instrument mechanisms such as reducing emissions from deforestation and forest degradation (REDD) represent the readiest opportunity for meeting and possibly improving upon reduction contributions from the region. Especially for countries such as Indonesia and Malaysia where deforestation is the major cause of greenhouse gas emissions, REDD and avoided deforestation together are the major tools available for realizing low-cost abatement. This is especially so since land-intensive development can be transferred to land areas that are already cleared or are degraded. REDD mechanisms are not only beneficial to Indonesia and Malaysia, as the ADB reports, "under a global carbon market, costs to other countries in the region are substantially reduced, as a result of lower carbon prices. In the medium term, the rest of Southeast Asia faces approximately 50 percent lower cost when REDD is in place than when it is not. Thus, REDD is beneficial to even those countries without a problem of forest destruction" (ADB 2015, 81).

Lessons Learned

- Deforestation and burning of forests in Southeast Asia have led to the destruction of carbon sinks, biodiversity hotspots, and habitat loss while also representing a social quandary due to the associated health and economic costs.
- Deforestation and land use changes account for over half of the yearly regional greenhouse gas emissions and most of these originate from land degradation and forest fires in Indonesia.
- Reducing deforestation in Southeast Asia and curbing damaging land clearing practices that use fire have sustainability implications at national, regional, and global scales. Forest conservation and avoided deforestation for short- to medium-term gains toward low-carbon development in the region.

Challenges and Barriers

Several challenges exist in designing a coordinated response to the local, regional, and global impacts of deforestation and haze in Southeast Asia. In order to maximize sustainability gains, policymakers at all three levels need to be cognizant of the multiple implications of this environmental problem.

At the national level, while promising initiatives like the moratorium have been enacted, more long-term steps need to be taken in order to abate the yearly forest fire crisis. Increasing disaster response capacities as well as the capabilities to quickly trace and extinguish fires should be a primary priority for provincial governments. Similarly, important is the strict enforcement of government legislation that penalizes land-burning practices. Sustainable landscape management policies need the active collaboration of local governments, communities, and industries. Financial and technical assistance need to be mobilized in order for farming practices to transition to more sustainable modes of clearing land. Overall transparency in the definition of land types and administrative procedures for land acquisition need to accompany policy directives that improve the use rights and tenure of local and customary communities. Valuation mechanisms of ecosystem services and the natural capital that is provided at the landscape level need to be deployed and their results made available to policymakers, non-government, and private stakeholders, alike. Incentives for forest conservation need to be clarified that makes the preservation of natural areas a competing option to intensive clearing and cultivation. Spatial data and mapping should be made available in order to reduce information asymmetries regarding land ownership.

Regional responses to deforestation-led haze are particularly important to design and implement as they have bearings on local initiatives as well as global directives. The importance that cooperative involvements of members of the ASEAN can have has thus far been underplayed and not fully optimized. ASEAN agreements that have been signed in the context need to be legally binding with compliance-monitoring mechanisms. The creation of legal benchmarks or standards of air pollution need a regional institutional platform and ASEAN would be the most suitably poised form to take the lead. ASEAN could also provide a venue for members to monitor their own and others' progress toward meeting their INDC's pledged for the Paris Agreement. With the Singapore THPA now in its second year of implementation, the act could be recalibrated to include direct communication and coordination with provincial governments in Indonesia in the jurisdiction in which fires generally occur.

In order to maximize the mitigation gains from avoided deforestation, nations of the ASEAN need to continue taking steps to engage with REDD+ efforts, with Indonesia and Malaysia taking the lead. Affluent countries of the region such as Singapore could be more involved in REDD+ projects in Indonesia in order to mitigate emissions but also to have a more direct stake at monitoring landscape changes. Linking forest mapping efforts for REDD+ can help to define global and regionally transparent definitions of reference levels of emissions. At the same time, afforestation policies should be enacted in order to restore degraded areas and revegetate land areas that have been cleared but remain unused.

Notes

1. http://news.asiaone.com/news/singapore/record-power-consumption-hot-hazy-june
   http://www.todayonline.com/singapore/daily-water-usage-exceeds-level-during-haze-last-year
2. http://www.wri.org/topic/indonesia-forest-fires
3. https://www.wri.org/sites/default/files/indonesia-forest-moratorium-next-steps.pdf
4. "Haze episode cost Singapore S$700m last year: Masagos", *Channel News Asia*, March 15, 2016. http://www.channelnewsasia.com/news/singapore/haze-episode-cost/2605406.html
5. World Resources Institute (WRI) Climate Data Explorer. http://cait.wri.org
6. http://newsroom.unfccc.int/unfccc-newsroom/finale-cop21/

Further Reading and References

ADB. 2015. *Southeast Asia and the Economics of Global Climate Stabilization*. Manila: Asian Development Bank.

Elliott, L. 2003. ASEAN and Environmental Cooperation: Norms, Interests and Identity. *The Pacific Review* 16 (1): 29–52.

Fargione, J., J. Hill, D. Tilman, S. Polasky, and P. Hawthorne. 2008. Land Clearing and the Biofuel Carbon Debt. *Science* 319 (5867): 1235–1238.

Forsyth, T. 2014. Public Concerns About Transboundary Haze: A Comparison of Indonesia, Singapore, and Malaysia. *Global Environmental Change* 25: 76–86.

Glover, D., and T. Jessup. 2006. *Indonesia's Fires and Haze: The Cost of Catastrophe*. Ottawa: IDRC.

Heil, A., and J. Goldammer. 2001. Smoke-Haze Pollution: A Review of the 1997 Episode in Southeast Asia. *Regional Environmental Change* 2 (1): 24–37.

Jakarta. 1999. Planning for Fire Prevention and Drought Management Project. Cause, Extent, Impact, and Cost of 1997/1998 Fires and Drought. *BAPPENAS-ADB* 2.

Koplitz, S.N., L.J. Mickley, M.E. Marlier, J.J. Buonocore, P.S. Kim, T. Liu, M.P. Sulprizio, R.S. DeFries, D.J. Jacob, J. Schwartz, and M. Pongsiri. 2016. Public Health Impacts of the Severe Haze in Equatorial Asia in September–October 2015: Demonstration of a New Framework for Informing Fire Management Strategies to Reduce Downwind Smoke Exposure. *Environmental Research Letters* 11 (9): 094023.

Lee, J.S.H., Z. Jaafar, A.K.J. Tan, L.R. Carrasco, J.J. Ewing, D.P. Bickford, E.L. Webb, and L.P. Koh. 2016. Toward Clearer Skies: Challenges in Regulating Transboundary Haze in Southeast Asia. *Environmental Science & Policy* 55: 87–95.

Mayer, J. 2006. Transboundary Perspectives on Managing Indonesia's Fires. *The Journal of Environment & Development* 15 (2): 202–233.

McCaffrey, S.C. 2015. Pollution of Shared Freshwater Resources in International Law. In *Transboundary Pollution. Evolving Issues of International Law and Policy*, ed. S. Jayakumar, T. Koh, R. Beckman, and H.D. Phan. Cheltenham: Edward Elgar.

Nurhidayah, L., S. Alam, and Z. Lipman. 2015. The Influence of International Law upon ASEAN Approaches in Addressing Transboundary Haze Pollution in Southeast Asia. *Contemporary Southeast Asia: A Journal of International and Strategic Affairs* 37 (2): 183–210.

Othman, J., M. Sahani, M. Mahmud, and M.K.S. Ahmad. 2014. Transboundary Smoke Haze Pollution in Malaysia: Inpatient Health Impacts and Economic Valuation. *Environmental Pollution* 189: 194–201.

Page, S.E., F. Siegert, J.O. Rieley, H.D.V. Boehm, A. Jaya, and S. Limin. 2002. The Amount of Carbon Released from Peat and Forest Fires in Indonesia During 1997. *Nature 420* (6911): 61–65.

Quah, E. 2002. Transboundary Pollution in Southeast Asia: The Indonesian Fires. *World Development* 30 (3): 429–441.

Quah, E., and H. Varkkey. 2013. The Political Economy of Transboundary Pollution: Mitigation of Forest Fires and Haze in Southeast Asia. *The Asian Community: Its Concepts and Prospects,* 323–358. Tokyo: Waseda University.

Ramdani, F., and M. Hino. 2013. Land Use Changes and GHG Emissions from Tropical Forest Conversion by Oil Palm Plantations in Riau Province, Indonesia. *PLoS One* 8 (7): e70323.

Reddington, C.L., M. Yoshioka, R. Balasubramanian, D. Ridley, Y.Y. Toh, S.R. Arnold, and D.V. Spracklen. 2014. Contribution of Vegetation and Peat Fires to Particulate Air Pollution in Southeast Asia. *Environmental Research Letters* 9 (9): 94–106.

Shortle, J.S., D.G. Abler, and R.D. Horan. 1998. Research Issues in Nonpoint Pollution Control. *Environmental and Resource Economics 11* (3–4): 571–585.

Siegert, F., G. Ruecker, A. Hinrichs, and A.A. Hoffmann. 2001. Increased Damage from Fires in Logged Forests During Droughts Caused by El Nino. *Nature* 414 (6862): 437–440.

Tacconi, L., F. Jotzo, and R.Q. Grafton. 2008. Local Causes, Regional Co-Operation and Global Financing for Environmental Problems: The Case of Southeast Asian Haze Pollution. *International Environmental Agreements: Politics, Law and Economics* 8 (1): 1–16.

UNESCAP. 2016. Climate Finance in and Beyond the Paris Agreement: Implementing Climate Finance Committments in Asia and the Pacific. Discussion paper: First High-Level Follow-Up Dialogue on Financing for Development in Asia and the Pacific. UNESCAP Incheon, Korea. March 30–31, 2016.

Van der Werf, G.R., J.T. Randerson, L. Giglio, G.J. Collatz, M. Mu, P.S. Kasibhatla, D.C. Morton, R.S. DeFries, Y.V. Jin, and T.T. Van Leeuwen. 2010. Global Fire Emissions and the Contribution of Deforestation, Savanna, Forest, Agricultural, and Peat Fires (1997–2009). *Atmospheric Chemistry and Physics* 10 (23): 11707–11735.

World Bank. 2016. The Cost of Fire: An Economic Analysis of Indonesia's 2015 Fire Crisis. *Indonesia Sustainable Landscapes Knowledge*. World Bank: Jakarta. Yong, D.L. and Peh, K.S.H. South-east Asia's Forest Fires: Blazing the Policy Trail. *Oryx* 50(02): 207–212.

4

Sustainable Water Resources Management: Groundwater Depletion

Brian F. Thomas and Aimee C. Gibbons

Background

Our global population depends on access to water. Inadequate access to this precious resource will impact more than one billion lives (Gleick 1998). Simultaneously, more than two billion people fight waterborne diseases (Prüss-Üstü et al. 2008). Changes in the distribution, timing, and volume of precipitation and increases in global temperatures as a result of changes in global climate intersect with increases in water demands as populations grow, hindering our ability to manage water resources effectively. Evidence suggests increasing global rates of water fluxes (i.e. precipitation, evapotranspiration, discharge) (Syed et al. 2010; Huntington 2006; Vorosmarty and Sahagian 2000; Lane et al. 1999; Loaiciga et al. 1996; Rodell et al. 2015), whereas climate models offer predictions of drying in mid-latitudes and wetting in high and low latitudes (IPCC 2007). Managing water supplies to fulfill user demands over time and space (Israel and Lund 1995) requires a sustainable approach to develop rational water policies and management plans. Continued vigilance is a necessary step to monitoring the effectiveness of water resources management activities (Gleick 1988; Liu et al. 2008; Vorosmarty et al. 2000a, b; Vorosmarty et al. 2010).

Water resources management is most strained during extreme events: cases of too much water (i.e. floods) or too little water (i.e. droughts). This strain is

B. F. Thomas (✉)
University of Pittsburgh, Pittsburgh, PA, USA

A. C. Gibbons
University of California, Irvine, CA, USA

R. Brinkmann, S. J. Garren (eds.), *The Palgrave Handbook of Sustainability*,
https://doi.org/10.1007/978-3-319-71389-2_4

concerning, given the increasing frequency of extreme events (Trenberth 2012) as a result of the nonstationary response of the hydrologic cycle to climate change. Droughts, in particular, require water resources management strategies to avoid the proverbial "hydro-illogical cycle" (attributed to Tannehill 1947) whereby concerns over the lack of resources to fulfill demands are quickly forgotten with the return of regular precipitation events. Historically, water managers met the challenge of the poor temporal distribution of demand and availability by constructing water storage infrastructure, thereby controlling the variability of streamflow (McMahon and Adeloye 2005). In the USA, dam building was spurred by multipurpose infrastructure to harness streamflow for flood control, hydropower production, and irrigation/water supply, peaking in the 1960s (National Inventory of Dams 2016) prior to environmental regulations that encumber reservoir construction today.

Analogous to surface water reservoirs, geological formations beneath the surface readily store, transmit, and produce water resources of sufficient quantity and quality to fulfill water demands. This subsurface resource, groundwater, provides critical freshwater resources for more than 2 billion people (Clarke et al. 1996) and stores an estimated 90 percent of Earth's non-frozen freshwater (Koundouri 2004). Our understanding of subsurface hydrology expanded in the early twentieth century (Pennink 1905; Theis 1940; Meinzer 1923; Todd and Mays 2005), literally changing the landscape given rapid changes in agriculture globally (Tilman et al. 2002) as groundwater resources were tapped to fulfill water demands not connected to resilient surface water supplies. Groundwater provides a reliable water resource given its residence time, the ratio of storage to the net flux, which can exceed millions of years (Sturchio et al. 2004; Patterson et al. 2005). Thus, groundwater storages tend to respond at longer time scales as compared to rapid changes in precipitation and streamflow (Changnon 1987) and provide water security, especially in regions prone to prolonged drought (Kundzewicz and Doll 2009). As described by Theis (1940), groundwater abstractions are fulfilled from a decrease in storage (i.e. depletion of the aquifer), increases in recharge (i.e. induced recharge), and/or decreases in groundwater discharge (i.e. spring flow and baseflow). Groundwater studies indicate that global groundwater use is occurring at rates that exceed natural rates of recharge (Doll 2009; Wada et al. 2010; Gleeson et al. 2012; Konikow and Kendy 2005; Konikow 2011; Famiglietti 2014; Richey et al. 2015a), particularly in arid regions underlain by nonrenewable aquifers (Margat and Van der Gun 2013). Continued use (and overuse) of groundwater resources reduces the volume of groundwater in storage, resulting in land subsidence (Poland 1972), reduction of surface

flows, low flows (Brandes et al. 2005; Barlow and Leake 2012), and cascading impacts on water supplies (Konikow and Kendy 2005).

Historically, only isolated aquifers were monitored to provide extensive in situ records of groundwater elevations to evaluate rates of groundwater depletion (Fishel 1956; Meinzer 1923; Scanlon et al. 2012). Knowledge of the state of groundwater systems is often limited given the expense of monitoring groundwater systems (Foster and Chilton 2003). Recent advances in Earth observations have provided new insight into large-scale groundwater processes (Famiglietti et al. 2015; Chen et al. 2016; Richey et al. 2015a). These technologies, however, provide hydrologic information at too coarse of a resolution for local/regional water management decisions (Alley and Konikow 2015) and fail to account for aquifer response to withdrawals that are balanced through capture (Lohman 1972). The latter provides an important indicator of sustainable management (Alley and Konikow 2015; Pandey et al. 2011; Gleeson et al. 2012).

The continued evolution of sustainable water resources management for groundwater systems began with the concept of safe yield (Lee 1915), which defined the maximum amount of water that can be produced from an aquifer while maintaining aquifer storage as equal to the recharge. Safe yield was recognized as easily attainable for legal concepts pertaining to water rights (Bagley 1961) but was replaced by the concept of groundwater sustainability, a notion derived in large part from the work of Theis (Sophocleous 1997; Bredehoeft 1997; Alley and Leake 2004; Zhou 2009). Current expressions of groundwater sustainability require more than a "no-net withdrawal" condition (Bredehoeft 1997; Alley and Leake 2004) and instead seek to understand temporal patterns of withdrawals and recharge that define groundwater dynamics.

Similar to the Brundtland (Brundtland 1985) definition of sustainable development, where we may "meet the needs of the present without compromising the ability of future generations to meet their own needs", sustainable groundwater principles seek to maintain groundwater resources in such a fashion that, while accounting for long-term equilibrium changes that occur as a result of groundwater withdrawals (Alley and Leake 2004), permits the use of the aquifer in perpetuity. Pandey et al. (2011) advocate that groundwater behaviors are just one component in sustainable groundwater management, defining a framework that accounts for the dimensions of social, economic, and institutional components along with mutual trust in information exchange and environmental characteristics. Gleeson et al. (2012) advocate for integrative management, a strategy that includes adaptive management. An important aspect of these sustainable groundwater management approaches

is the assessment of groundwater dynamics as aquifers respond to changes in management strategies (Zhou 2009; Pandey et al. 2011). The case study presented in this chapter provides an important example of an assessment of sustainable water management practices in a local aquifer system in California which has undergone a variety of management strategies that have led to the current aquifer conditions.

Case Study

Groundwater depletion has been documented throughout California in regions of intense groundwater use (Famiglietti et al. 2011; Scanlon et al. 2012; Nelson 2012; Faunt 2009), which resulted in land subsidence and aquifer compaction (Poland 1972; Sneed et al. 2013; Farr et al. 2015; Galloway et al. 1998) with possible links to seismicity (Amos et al. 2014). In the Coachella Valley of Southern California (Fig. 4.1), a history of groundwater use dates back to the 1910s. Pillsbury (1941) documented that the majority of groundwater use was for irrigation of cotton and citrus, estimating that 90

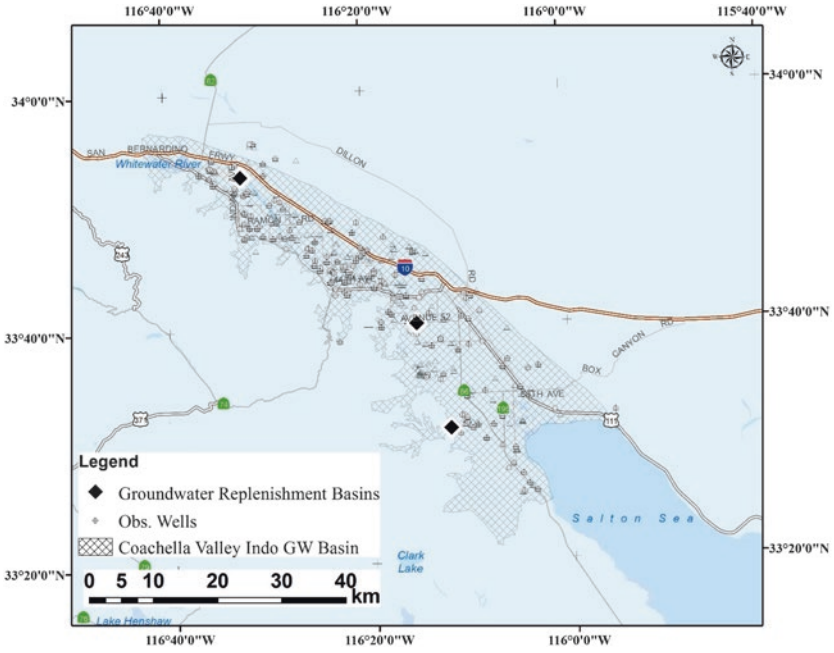


Fig. 4.1 Site map illustrating the location of groundwater observation wells and groundwater replenishment locations within the Coachella Valley

percent of irrigation application rates, of up to 2.95 meters applied annually, were for citrus crops. Tenfold increases in withdrawals between 1936 and 1967 resulted in observations of 30 meters or more in aquifer elevation declines (Tyley 1974) with annual groundwater depletion rates of 1.5 meters per year reported near Palm Springs (Swain 1978). This overuse of groundwater initiated a water management response that produced a complex arrangement of surface water allocations, groundwater withdrawals, water reuse, and groundwater banking managed by multiple water agencies including the Coachella Valley Water District, Coachella Water Authority, Desert Water Agency, Indio Water Authority, and the Mission Springs Water District.

This case study presents an analysis of historic groundwater elevation data, climate represented as various drought indices, and annual water deliveries in order to characterize the influence of groundwater management on aquifer system behavior. This analysis focuses on the use of in situ observations of groundwater elevations to provide a means to measure the impact of natural and anthropogenic influences over time using an extensive network of observation wells located in the Coachella Valley (Fig. 4.1). In the analysis, we discuss various concepts of sustainable groundwater management in an effort to assess the impact of management strategies undertaken in the Valley.

Site Characteristics

The Coachella Valley is a northwest-trending valley in Southern California spanning from the San Bernardino Mountains to the north and the Salton Sea to the south (Fig. 4.1). The Salton Trough, a ridge-transform fault system (McKibben 1993), was filled by deltaic deposits from the Colorado River with reported depths up to 3700 meters. The primary aquifer system is separated into an upper zone (45–90 meters below grade) and a lower zone (90–180 meters below grade) with semi-confining layers throughout the aquifer system (Sneed and Brandt 2013).

A combination of geologic controls and aquifer management by multiple water agencies creates a variable aquifer response across the valley. Structural geologic features including the San Andreas Fault Zone influence groundwater response by impeding flow (California Department of Water Resources 1964), resulting in dramatically different groundwater elevations across the geologic features. Hydraulic connection to the Salton Sea is limited by fine-textured lake deposits, creating a confining layer between the surface water body and aquifer (Reichard and Meadows 1992). Despite close coordination and interaction between the multiple water agencies in the Coachella Valley,

each agency approaches groundwater management differently to meet the needs of their specific water users.

The basin hydroclimatology typifies the arid regions found throughout the Southwestern USA. The arid valley averages 80–100 mm of annual precipitation on the valley floor with reported averages within mountain ranges of up to 800 mm (Reichard and Meadows 1992; Sneed et al. 2002). Typical in arid groundwater systems (Gee and Hillel 1988), natural groundwater recharge is restricted to induced recharge from losing streams and valley-edge recharge. Mendenhall (1909) identified the source of groundwater recharge to the valley aquifer from precipitation and runoff events from the bordering mountains; Swain (1978) estimated a net annual natural recharge of 44.4×10^6 cubic meters per year (m^3/yr) to the Whitewater Basin. By 1999, for comparison, total groundwater withdrawals were 463.8×10^6 m^3/yr or approximately 10 times that of estimated natural recharge. Artificial recharge to the aquifer via surface water imports obtained through transfers from the California State Water Project and the federal Central Valley Project, storm water capture, and through agreements to attain Colorado River allocations via the Quantification Settlement Agreement have been used to augment natural recharge since 1973.

History of Water Use

Coachella Valley water use was founded in agriculture (Pillsbury 1941), relying solely on groundwater withdrawals to fulfill water demands. Population centers, including Palm Springs, began to flourish in the 1930s as Hollywood elite discovered the region, making it into a desert oasis retreat (Culver 2010). Post World War II, populations rose dramatically, doubling per decade in Palm Springs, so too did developments to attract tourism to the region, primarily golf courses of which there are 124 as of 2015. As the growth of populations, tourist development, and agriculture grew, so too did water demands. Until the completion of the All-American canal in 1949, the region was entirely reliant upon the aquifer; the canal deliveries alleviated agricultural irrigation demands and initiated Coachella Valley's connection to water transfers from outside the region (Loeltz and Leake 1979). Water managers recognized the declines in aquifer elevations over time (Swain 1978) and commenced groundwater studies to evaluate the efficacy of artificial groundwater recharge (Swain 1978; Levy 1988; Mallory et al. 1980). Site conditions and promising increases in groundwater elevations spurred activation of the Whitewater Spreading Basins in 1973 in the northwest basin (Fig. 4.1). Replenishment

benefits were confirmed and additional recharge facilities were added in 2009 (Fig. 4.1). Thus, the current aquifer conditions are a convolution of historic groundwater use, overdraft, and artificial recharge that have occurred within a changing legal groundwater framework in California (Dinar et al. 1997).

Sustainable Groundwater Management Evaluation

An evaluation of groundwater dynamics over space and time is necessary to assess the efficacy of groundwater management (Pandey et al. 2011). In this section, we present a temporal evaluation that accounts for the influence of multiple factors that disturb groundwater elevations. Following the temporal investigation, we present a spatial assessment to characterize the spatial dynamics observed in the aquifer over time.

Groundwater elevations in the Coachella Valley were evaluated by averaging them per calendar year, in our case starting in 1960, as the number of observations per well in addition to the changing number of wells over time. Figure 4.2 compares groundwater elevations to the first year of the analysis (i.e. 1960); thus, for example, average groundwater elevations in 1961 were 2.73 meters below levels in 1960. Water use as reported by water agencies is largely a function of the combination of indoor water use, which typically exhibits low variability, and outdoor/agricultural use, which exhibits high

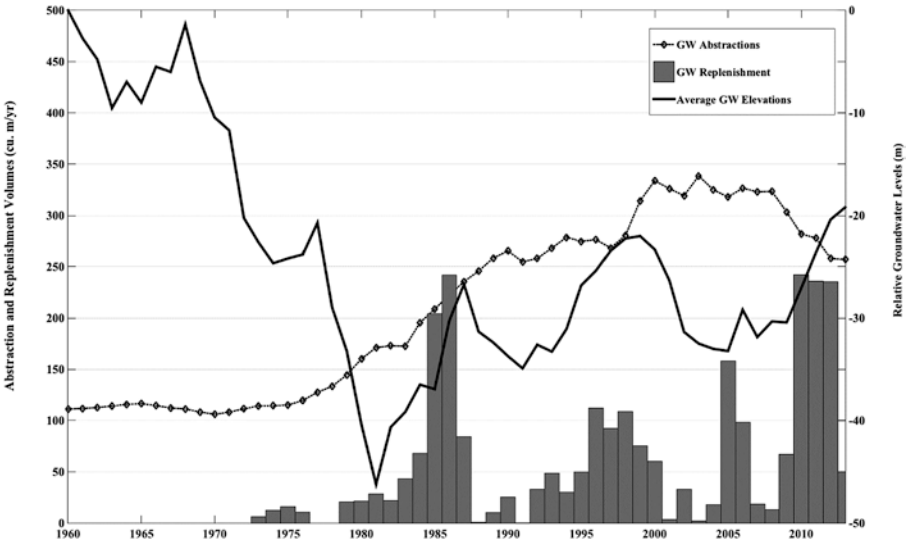


Fig. 4.2 Depiction of groundwater level changes compared with groundwater replenishment volumes to recharge the aquifer and groundwater abstractions

variability and seasonality. Groundwater abstraction rates have increased over time to meet growing water demands whereas canal flows have remained fairly static over time. Finally, inter-basin transfers for groundwater replenishment permit a comparison of average annual groundwater elevation and replenishment volumes to understand the relation of management in the evolution of the aquifer system. The continued depletion of the aquifer is apparent until approximately 1981, when large fluxes of surface water from the Colorado River flowed into the basin to replenish groundwater. Although aquifer recharge began in 1973, replenishment volumes were initially small and orders of magnitude smaller than withdrawal rates; thus artificial recharge activities provided relatively small benefits and only in near proximity to spreading basins (Thomas and Famiglietti 2015). A total of 19.12 km^3/yr of Colorado River flow is currently allocated under the Colorado Compact of 1922, representing more than the average annual flow of the Colorado (Christensen et al. 2004; Woodhouse et al. 2006); however, prior to 2000, major water users, including Arizona and Nevada, lacked adequate infrastructure to accept their full allotments. Therefore, excess Colorado River water was diverted into the Coachella Valley to augment natural recharge. Because these Colorado River users were able to accept their full allocation, coincident with a significant drought in the Colorado River watershed (Piechota et al. 2004), available surface water flows to recharge the aquifer diminished; groundwater elevations responded as a result of decreased replenishment flows and drought conditions (Fig. 4.2). Recognizing the positive impacts of groundwater replenishment, water managers in the Valley worked to secure inter-basin transfer agreements to provide continuous replenishment volumes in addition to initiating progressive water reuse and storm water capture programs. Spearheaded by the Coachella Valley Water District, sources claimed as a result of canal linings were secured through the Quantification and Settlement Agreement (QSA), totaling approximately 371.3 m^3/yr to flow into the region for groundwater replenishment, in addition to sources of water from the State Water Project and the Central Valley Project.

Note that groundwater elevations tend to increase near groundwater replenishment basins, whereas the central portion of the Valley exhibits decreasing groundwater elevations of up to 1 meter per year.

As evidenced in Fig. 4.3, average groundwater elevations fluctuate with withdrawals and the influx of replenishment volumes. Annual groundwater management reports (e.g. see CVWD 2015a, b) document a balanced aquifer net budget, generally defined as the difference between inflow and outflow, in recent years, whereby fluxes of recharge volumes, water reuse, and storm water recharge approximately equal withdrawal volumes. Between 1936 and 1999,

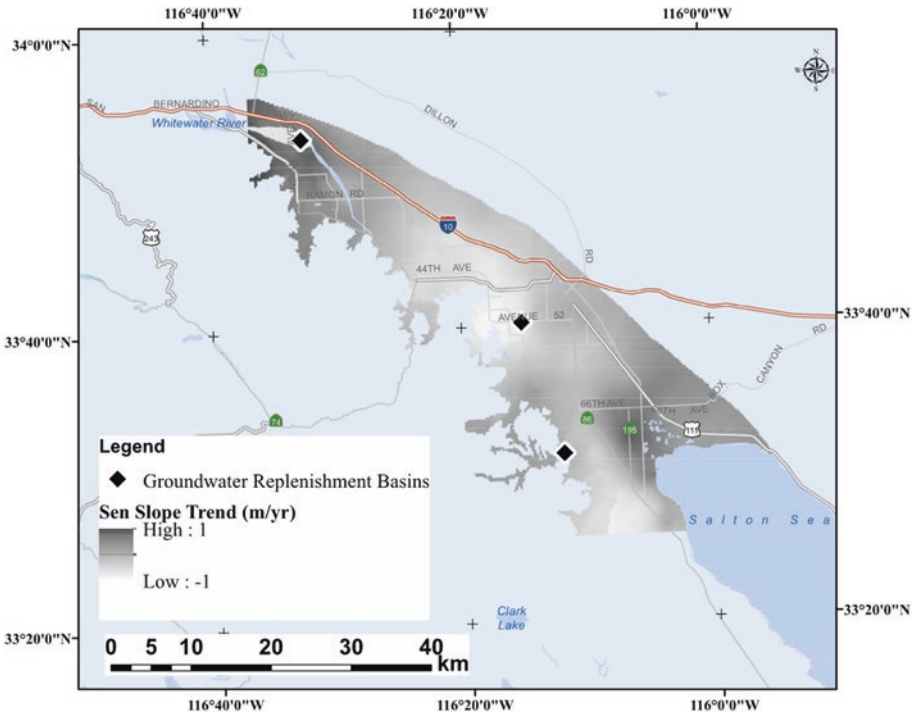


Fig. 4.3 Spatial interpolation of groundwater elevation trends across the Coachella Valley

however, an estimated net reduction of aquifer storage of 5.8 km^3 occurred, representing 4.3 meters of water across the entire basin.

Sustainable groundwater management approaches require an evaluation of spatiotemporal groundwater dynamics (Alley and Leake 2004) and an assessment of the performance of adaptive management strategies (Gleeson et al. 2012). An evaluation of the management approach in the Coachella Valley can be qualitatively assessed by addressing two important questions: (1) how sensitive are changes in groundwater elevations across the groundwater basin to inter-basin transfers for groundwater replenishment and (2) what is the spatial behavior of the aquifer over time?

Sensitivity to Adaptive Management Strategies

Under natural conditions, groundwater storage responds to changes in inflow (i.e. recharge) and outflow (i.e. natural discharges including springs and baseflow). As depicted in Fig. 4.2, average groundwater elevations fluctuate based

on the ratios of withdrawals and replenishment volumes, raising sustainable management questions regarding the temporal relationship between average groundwater elevations and management activities. The goal of this analysis is to determine the influence of replenishment activities and groundwater withdrawals on the average observed behavior of groundwater elevations in the Coachella Valley. Given the existence of extensive groundwater elevation data in the region, we used a hybrid multivariate statistical/physical modeling approach that exploits all available information. Such an approach is useful as it enables the making of quantitative and rigorous statements regarding the significance of the various factors that govern groundwater elevations in the Valley. In the evaluation, the proposed model shall include annual time series of climate represented as PDSI (Palmer 1965) and SPI (McKee et al. 1993), precipitation, and temperature in the Coachella Valley and replenishment volumes and withdrawal volumes as summarized in Table 12.1 for the time period of 1960 and 2013.

Ordinary least squares multivariate regression procedures were used to estimate model parameters given the model form:

$$\mathrm{GWE}_t = \sum_{i=1}^{n} \beta_i X_i + \varepsilon_t$$

Where GWE_t represents some function of average groundwater elevations over time, X_i are explanatory variables, β_i are model coefficients, and ε_t are normally distributed model errors with zero mean and constant variance σ^2. Tests for influence, inference, and multicollinearity were conducted (Helsel and Hirsch 2002) to identify explanatory variables to predict average changes in groundwater elevations using potential explanatory variables summarized in Table 4.1.

Table 4.1 Potential explanatory variables

Variable name	Description	Units
SPI	Standardized Precipitation Index	-
PDSI	Palmer Drought Stress Index	-
P	Precipitation (annual)	m/yr
T	Temperature (average annual)	°F
GW_{abs}, $\sum GW_{abs}$	Annual groundwater abstractions, sum of abstractions	Thousand m^3/yr
SW, $\sum SW$	Annual replenishment volumes, sum of replenishment volumes	Thousand m^3/yr

Several model forms were evaluated using stepwise regression analysis and goodness of fit metrics including prediction sum of squares (PRESS) and prediction R^2 (Helsel and Hirsch 2002). The following model form was selected where the response variable, GWE_t, represented the deviation of average groundwater elevations as compared to the 1960 levels illustrated in Fig. 4.2:

$$GWE_t = \beta_1 PDSI + \beta_2 \sum GW_{abs} + \beta_3 \sum SW$$

The t-ratios of the model coefficients, defined as the ratio of the model coefficient divided by its standard deviation, were large (3.18, -14.91, 11.02, respectively, for PDSI, $\sum GW_{abs}$ and $\sum SW$), which indicates that estimated coefficients are stable. In general, the model form suggests that average groundwater elevations are a function of drought characteristics, whereby more intensive drought results in a decrease in average groundwater elevations (PDSI<0 during drought), from aquifer withdrawals. These withdrawals, in turn, reduce average groundwater elevations and groundwater replenishment volumes, which increase average groundwater elevations. The model form and coefficients reflect the explanatory variables that account for the observed behavior of groundwater elevations; however, non-uniform coefficients hinder an evaluation of the influence of each variable (Table 4.1). To evaluate the sensitivity of groundwater elevation changes in explanatory variables, the nondimensional sensitivity concept of elasticity is used. Elasticity is defined as:

$$\varepsilon_x = \frac{\frac{\delta GWE_t}{GWE_t}}{\frac{\delta x}{x}} = \frac{\delta GWE_t}{\delta x}\frac{x}{GWE_t}$$

where x is the explanatory variable of interest. Elasticity ε_x represents the percentage change in the magnitude of GWE_t which results from a one percent change in the explanatory variable x. The evaluation identified the elasticity of PDSI, representing the influence of drought, to be 0.027, the elasticity of groundwater abstraction volumes to be 2.66 and replenishment volumes for groundwater recharge to be 2.28. These results suggest that, as expected, net influx to the aquifer strongly influences groundwater elevations, reflecting

a temporal response of management activities. In general, natural processes are negligible as compared to anthropogenic influences within the groundwater dynamics in the Coachella Valley. Furthermore, the maintenance of groundwater elevations is highly sensitive to replenishment, thus raising questions regarding diverse adaptive management strategies to achieve sustainable management goals.

Spatial Variability in Aquifer Dynamics

Evaluating only the net flux or average groundwater dynamics fails to meet the criteria of sustainable management advanced by Alley and Leake (2004), who specified that the spatiotemporal nature of groundwater dynamics is important to understand aquifer response to management. Thomas and Famiglietti (2015) evaluated spatial groundwater elevation trends in the Whitewater groundwater basin on a decade timescale; this analysis focused on groundwater behaviors after the installment of infiltration basins (1973–2013).

The analysis used groundwater elevation records for wells throughout the Coachella Valley. For each well, the magnitude of the trend is estimated using a nonparametric estimator, the Sen Slope estimator, given by:

$$b = \text{median}\left(\frac{Y_j - Y_i}{X_j - X_i}\right) \forall j > i$$

where Y represents the observed groundwater elevation at time X (Helsel and Hirsch 2002). To characterize groundwater dynamics, spatial interpolation of individual well trends was conducted using inverse-distance weighting (Thomas et al. 2016b; Richey et al. 2016; Sahoo et al. 2016).

Trend analysis results illustrated in Fig. 4.3 clearly depict positive groundwater elevation responses in the western and eastern portions of the Valley as a result of groundwater replenishment. The results, however, clearly show the limited spatial influence of groundwater replenishment, as dramatic declines in groundwater elevations, of up to 1 m/yr, continue in the central portion of the Valley. These results are consistent with trends evaluated by Thomas and Famiglietti (2015). Thus, despite replenishment benefits to groundwater storage, the groundwater system exhibits spatial variability suggestive of unsustainable groundwater systems.

Lessons Learned

A long history of groundwater overdraft, reported as early as the 1910s, has existed across the Coachella Valley as groundwater withdrawals increased to meet water demands. Today, the region relies on a complex mix of groundwater withdrawals, surface water allocations from the Colorado River, and water reuse to support an economy composed of agricultural production, golf courses, and tourism and population centers including Indio and Palm Springs.

Multiple water management decisions including agreements with water agencies outside the Valley have brought surface water allocations from the Colorado River to support groundwater replenishment and irrigation, alleviating the need for groundwater withdrawals to meet water demands. Further, conservation efforts including education and rebate programs have alleviated demands (MWH 2012), particularly during the prolonged drought in California that continued through 2016 (Williams et al. 2015; Mao et al. 2015).

Groundwater sustainability requires more than a "no-net withdrawal" from the aquifer, a strategy advocated by Bredehoeft (1997) and Alley and Leake (2004). Figure 4.3 illustrates the spatial response of the aquifer under management, showing the clear benefit of groundwater recharge activities in the positive groundwater elevations near the recharge facilities, while continued groundwater depletion is noted in the central portions of the Valley. Further, although average groundwater elevations have risen since ~1980 (Fig. 4.2), elevations remain more than 19 meters below 1960 levels. The adaptive management strategies employed by the water agencies in the Coachella Valley have produced positive results. During the prolonged drought in California, water users cut their water use by 25 percent in 2016 as a result of active engagement and education outreach combined with water use regulations promulgated by the water agencies. Current efforts seek to transfer golf course irrigation schemes to surface water diversions and water reuse, thereby reducing the impact of irrigation practices on groundwater abstraction rates. These continued efforts to reduce water demands will result in a positive groundwater response as evidenced in the estimate of groundwater abstraction elasticity, which predicts a one percent reduction in groundwater abstractions will result in a 2.66 percent improvement in average groundwater elevations.

Despite these management efforts, however, groundwater trends do not exhibit characteristics of a resilient management strategy. In the evaluation of

the sensitivity of average groundwater elevations, we showed that the cumulative rate of abstractions and the replenishment volumes for groundwater recharge largely regulated behaviors. Of specific concern is the reliance on out-of-basin surface water supplies for groundwater recharge, primarily from the Colorado River watershed. The future reliability of continued "status quo" allocations from the Colorado River is, at best, uncertain (Barnett and Pierce 2008, 2009), especially given changing climates (Cayan et al. 2010; Seager et al. 2013; Stine 1990, 1994; Harding et al. 1995; Haron and Dragovich 2010). Although current management efforts have shown positive groundwater storage changes, the effect has come at the cost of moving water from an over-allocated basin (the Colorado) to recharge groundwater in an arid basin. Further, water agencies must strive to produce a portfolio of adaptive management efforts to alleviate groundwater depletion in the central portion of the Valley.

Challenges and Barriers

The uncertainty of climate change (IPCC 2007) combined with ever-increasing water demands hinders water resources planning, especially in regard to groundwater management (Taylor et al. 2013; Holman 2006; Thomas et al. 2016a, b; Green et al. 2011; Scibek and Allen 2006). In the case of Coachella Valley, we did not discuss two important topics: the impact to ecosystems which depend on groundwater flux (Klove et al. 2011a, b; Howard and Merrifield 2010) and water quality (Gleeson et al. 2010; Devlin and Sophocleous 2005; Zhou 2009). In the Coachella Valley, conservationists advocate balancing water demands with ecosystem demands to maintain species habitats (Dudek 2014), thus spurring water agencies in the region to move toward a well-defined, adaptive management approach toward sustainable groundwater management. Well-defined water quality issues have been evaluated in the Coachella Valley (Swain 1978; Goldrath et al. 2009; Dawson and Belitz 2013) raising many questions regarding the ability of the aquifer system to maintain current management strategies, risking water security for the entire region. Annual or decadal averages of groundwater constituent concentrations are often used to evaluate water quality (Lindsey and Rupert 2012; CVWD 2015a, b), but our quantitative analysis demonstrates the importance of considering the spatial and temporal variability in order to fully address sustainability. Nitrates, for example, are a primary component in fertilizer, and are expected to vary seasonally, with higher concentrations in surface runoff and groundwater recharge coinciding with growing seasons

in agricultural regions (McMahon et al. 2007). Lastly, in California, groundwater regulations have been enacted in an effort to provide guidelines to achieve sustainable management (Bales et al. 2016; Nishikawa 2016). Given the history of legal recourse in managing water in the west (Weatherford et al. 1982; Gray 1993; Sax 2002), the likelihood of legal and scientific challenges to groundwater regulation is high. Further, current water rights reflect the "first in time, first in right" doctrine (Shupe et al. 1989) which includes the requirement of continuous non-beneficial uses; such antiquated doctrines require land owners to essentially use water or lose water rights connected to the property. Overcoming these legal barriers will undoubtedly be difficult, as evidenced in the history of groundwater regulations in California (Sax 2002; Kanazawa 2003).

From a global perspective, sustainable groundwater management requires an understanding of the aquifer systems. The uncertainty in global groundwater storage volumes (Richey et al. 2015b) remains problematic, significantly limiting our ability to manage the resource. Recent studies have evaluated the "groundwater footprint" (Gleeson et al. 2012) to define the recharge area necessary to achieve sustainability. Results of such an analysis further highlight the transboundary nature of hydrologic systems, further complicating sustainable management (Barberis 1991; Blomquist and Ingram 2003; Voss et al. 2013).

Perhaps the most difficult challenge to sustainable groundwater management is the interdisciplinary nature of actors that must align in an effort to achieve sustainability goals (Gleeson et al. 2012; Pandey et al. 2011). Klove et al. (2014) referenced groundwater sustainability as a "value-driven" process that balances society, economics, and the environment. Accounting for the economic factors in sustainable management decisions is important (Pandey et al. 2011; Dinar and Letey 1991; Easter et al. 1998; Dinar and Zilberman 2012), especially within the Coachella Valley. The large number of golf courses, which attract numerous tourists to the region, and agriculture drives proportionately large water demands; these industries, however, are significant economic drivers in the region. An approach of sustainable management could, therefore, identify the economic benefit of these industries as an offset to the value of the environmental impact over some period of time; in other words, short-term depletion within a dimension of sustainable management can be offset by a short-term benefit in a competing dimension of sustainable management (Pandey et al. 2011; Alley and Konikow 2015). Sustainable water management requires efficient irrigation use, in addition to economic factors, in the mitigation of groundwater depletion. Residents of the Valley have worked through complex interdisciplinary planning processes (Alagona

and Pincetl 2008; Goldstein 2010), underscoring that overcoming complex obstacles requires continued effort and maintenance of goals.

Further Reading

Sustainable groundwater management in the Coachella Valley has been studied by Thomas and Famiglietti (2015); a complete and well-documented history of management strategies can be found in report archives from the Coachella Valley Water District (www.cvwd.org/archieves.aspx). The recent literature on sustainable groundwater management has grown exponentially in recent years, initiated by the work of Alley and Leake (2004); Pandey et al. (2011) worked to quantitatively evaluate sustainable groundwater management, providing insight into the institutions and stakeholders at play to effectively regulate sustainable management approaches. Joseph Sax, a preeminent water law scholar, presents a harsh but compelling legal history of California water law (Sax 2002), highlighting many of the issues being discussed during the promulgation of the Sustainable Groundwater Management Act in California (Moran and Cravens 2015). The crux of water management shall always be the space-time dilemma (Israel and Lund 1995) and the efficient use of water in the state (Lipson 1978); such is the case in any water resources management scenario.

References

Alagona, P.S., and S. Pincetl. 2008. The Coachella Valley Multiple Species Habitat Conservation Plan: A Decade of Delays. *Environmental Management* 41 (1): 1–11. https://doi.org/10.1007/s00267-007-9018-x.

Alley, W.M., and L.F. Konikow. 2015. Bringing GRACE Down to Earth. *Groundwater* 53 (6): 826–829. https://doi.org/10.1111/gwat.12379.

Alley, M., and S.A. Leake. 2004. The Journey from Safe Yield to Sustainability. *Ground Water* 42 (1): 12–16.

Amos, C.B., P. Audet, W.C. Hammond, R. Burgmann, I.A. Johanson, and G. Blewitt. 2014. Uplift and Seismicity Driven by Groundwater Depletion in Central California. *Nature* 509 (7501): 483–486. https://doi.org/10.1038/nature13275.

Bagley, E.S. 1961. Water Rights Law and Public Policies Relating to Ground Water Mining in the Southwestern States. *The Journal of Law & Economics* 4: 144–174.

Bales, Conklin, Viers, Fisher, Fogg, and M. Kiparsky. 2016. Foundations for California's Water Security in a Changing Climate. In *Water and Fire: Impacts of Climate Change*, 1604010. Merced: UC Merced.

Barberis, J. 1991. Development of International Law of Transboundary Groundwater. *The Natural Resources Journal* 31: 167.

Barlow, P.M., and S.A. Leake. 2012. *Streamflow Depletion by Wells—Understanding and Managing the Effects of Groundwater Pumping on Streamflow*, US Geological Survey Circular 1376, 84. Also available at http://pubs.usgs.gov/circ/1376/.

Barnett, T.P., and D.W. Pierce. 2008. When Will Lake Mead Go Dry? *Water Resources Research* 44 (3). https://doi.org/10.1029/2007wr006704.

———. 2009. Sustainable Water Deliveries from the Colorado River in a Changing Climate. *Proceedings of the National Academy of Sciences of the United States of America* 106 (18): 7334–7338. https://doi.org/10.1073/pnas.0812762106.

Blomquist, W., and H.M. Ingram. 2003. Boundaries Seen and Unseen—Resolving Transboundary Groundwater Problems. *Water International* 28 (2): 162–169.

Brandes, D., J.G. Hoffmann, and J.T. Mangarillo. 2005. Base Flow Recession Rates, Low Flows, and Hydrologic Features of Small Watersheds in Pennsylvania, USA. *Journal of the American Water Resources Association* 41 (5): 1177–1186. https://doi.org/10.1111/j.1752-1688.2005.tb03792.x.

Bredehoeft, J. 1997. Safe Yield and the Water Budget Myth. *Ground Water* 35 (6): 929–929. https://doi.org/10.1111/j.1745-6584.1997.tb00162.x.

Brundtland, G.H. 1985. Environmental Policy and Law. *World Commission on Environment and Development* 14 (1): 26–30.

*California Department of Water Resources.*1964. Coachella Valley Investigation: Bulletin 108, 145.

Cayan, D.R., T. Das, D.W. Pierce, T.P. Barnett, M. Tyree, and A. Gershunov. 2010. Future Dryness in the Southwest US and the Hydrology of the Early 21st Century Drought. *Proceedings of the National Academy of Sciences of the United States of America* 107 (50): 21271–21276. https://doi.org/10.1073/pnas.0912391107.

Changnon, S.A. 1987. *Detecting Drought Conditions in Illinois*. Vol. 169. Champaign: Illinois State Water Survey.

Chen, J.L., J.S. Famiglietti, B.R. Scanlon, and M. Rodell. 2016. Groundwater Storage Changes: Present Status from GRACE Observations. *Surveys in Geophysics* 37 (3): 397–701. https://doi.org/10.1007/s10712-016-9370-6.

Christensen, N.S., A.W. Wood, N. Voisin, D.P. Lettenmaier, and R.N. Palmer. 2004. The Effects of Climate Change on the Hydrology and Water Resources of the Colorado River Basin. *Climatic Change* 62 (1–3): 337–363. https://doi.org/10.1023/B:CLIM.0000013684.13621.1f.

Clarke, R., A. Lawrence, and S.S. Foster. 1996. *Groundwater: A Threatened Resource*. Vol. 15. Nairobi: United Nations Environment Programme.

Culver, L. 2010. *The Frontier of Leisure: Southern California and the Shaping of Modern America*. New York: Oxford University Press.

CVWD. 2015a. *2015 Domestic Water Quality Report.* http://www.cvwd.org/ArchiveCenter/ViewFile/Item/427

———. 2015b. *Coachella Valley Water District Engineer's Report on Water Supply and Replenishment Assessment for the West Whitewater River Subbasins Area of Benefit, 2015/2016*. http://www.cvwd.org/ArchiveCenter/ViewFile/Item/255

Dawson, B.J.M., and K. Belitz. 2013. *Groundwater Quality in Coachella Vallely, California*. Reston: US Department of the Interior, US Geological Survey.

Devlin, J.F., and M. Sophocleous. 2005. The Persistence of the Water Budget Myth and Its Relationship to Sustainability. *Hydrogeology Journal* 13 (4): 549–554. https://doi.org/10.1007/s10040-004-0354-0.

Dinar, A., and J. Letey. 1991. Agricultural Water Marketing, Allocative Efficiency, and Drainage Reduction. *Journal of Environmental Economics and Management* 20 (3): 210–223.

Dinar, A., and D. Zilberman, eds. 2012. *The Economics and Management of Water and Drainage in Agriculture*. New York: Springer.

Dinar, A., M.W. Rosegrant, and R.S. Meinzen-Dick. 1997. *Water Allocation Mechanisms: Principles and Examples (No. 1779)*. Washington, DC: World Bank Publications.

Doll, P. 2009. Vulnerability to the Impact of Climate Change on Renewable Groundwater Resources: A Global-Scale Assessment. *Environmental Research Letters* 4 (3). https://doi.org/10.1088/1748-9326/4/3/035006.

Dudek. 2014. *Coachella Valley Multiple Species Habitat Conservation Plan*. http://www.cvmshcp.org/PDFs_for_Website_Feb_28/FINAL%20SEIR-SEIS,%20CVMSHCP%20Major%20Amendment%20-%203-2014.pdf.

Easter, K.W., M.W. Rosegrant, and A. Dinar. 1998. *Markets for Water: Potential and Performance*. Vol. 15. New York: Springer.

Famiglietti, J.S. 2014. The Global Groundwater Crisis. *Nature Climate Change* 4 (11): 945–948.

Famiglietti, J.S., M. Lo, S.L. Ho, J. Bethune, K.J. Anderson, T.H. Syed, and M. Rodell. 2011. Satellites Measure Recent Rates of Groundwater Depletion in California's Central Valley. *Geophysical Research Letters* 38. https://doi.org/10.1029/2010gl046442.

Famiglietti, J.S., A. Cazenave, A. Eicker, J.T. Reager, M. Rodell, and I. Velicogna. 2015. Satellites Provide the Big Picture. *Science* 349 (6249): 684–685. https://doi.org/10.1126/science.aac9238.

Farr, T.G., C. Jones, and Z. Liu. 2015. *Progress Report: Subsidence in the Central Valley, California*. http://water.ca.gov/groundwater/docs/NASA_REPORT.pdf.

Faunt, C.C., ed. 2009. *Groundwater Availability of the Central Valley Aquifer, California: U.S.,* Geological Survey Professional Paper, vol. 1766, 225. Reston: US Geological Survey.

Fishel, V.C. 1956. Long-term Trends of Ground-Water Levels in the United States. *Eos, Transactions American Geophysical Union* 37 (4): 429–435.

Foster, S.S.D., and P.J. Chilton. 2003. Groundwater: The Processes and Global Significance of Aquifer Degradation. *Philosophical Transactions of the Royal Society of London Series B-Biological Sciences* 358 (1440): 1957–1972. https://doi.org/10.1098/rstb.2003.1380.

Galloway, D.L., K.W. Hudnut, S.E. Ingebritsen, S.P. Phillips, G. Peltzer, F. Rogez, and P.A. Rosen. 1998. Detection of Aquifer System Compaction and Land

Subsidence Using Interferometric Synthetic Aperture Radar, Antelope Valley, Mojave Desert, California. *Water Resources Research* 34 (10): 2573–2585. https://doi.org/10.1029/98wr01285.

Gee, G.W., and D. Hillel. 1988. Groundwater Recharge in Arid Regions—Review and Critique of Estimation Methods. *Hydrological Processes* 2 (3): 255–266. https://doi.org/10.1002/hyp.3360020306.

Gleeson, T., J. VanderSteen, M.A. Sophocleous, M. Taniguchi, W.M. Alley, D.M. Allen, and Y.X. Zhou. 2010. Groundwater Sustainability Strategies. *Nature Geoscience* 3 (6): 378–379.

Gleeson, T., Y. Wada, M.F.P. Bierkens, and L.P.H. van Beek. 2012. Water Balance of Global Aquifers Revealed by Groundwater Footprint. *Nature* 488 (7410): 197–200. https://doi.org/10.1038/nature11295.

Gleick, P.H. 1988. The Effects of Future Climatic Changes on International Water Resources: The Colorado River, the United States, and Mexico. *Policy Sciences* 21 (1): 23–39.

Gleick, P.H. 1998. Water in Crisis: Paths to Sustainable Water Use. *Ecological Applications* 8 (3): 571–579. https://doi.org/10.2307/2641249.

Goldrath, D.A., M.T. Wright, and K. Belitz. 2009. *Ground-Water Quality Data in the Coachella Valley Study Unit, 2007: Results from the California GAMA Program*, Data Series 373, 70. Reston: US Geological Survey.

Goldstein, B.E. 2010. The Weakness of Tight Ties: Why Scientists Almost Destroyed the Coachella Valley Multispecies Habitat Conservation Plan in Order to Save It. *Environmental Management* 46 (2): 268–284. https://doi.org/10.1007/s00267-010-9522-2.

Gray, B.E. 1993. The Modern Era in California Water Law. *Hastings LJ* 45: 249.

Green, T.R., M. Taniguchi, H. Kooi, J.J. Gurdak, D.M. Allen, K.M. Hiscock, and A. Aureli. 2011. Beneath the Surface of Global Change: Impacts of Climate Change on Groundwater. *Journal of Hydrology* 405 (3–4): 532–560. https://doi.org/10.1016/j.jhydrol.2011.05.002.

Harding, B.L., T.B. Sangoyomi, and E.A. Payton. 1995. Impacts of a Severe Sustained Drought on Colorado-River Water-Resources. *Water Resources Bulletin* 31 (5): 815–824.

Haron, M., and D. Dragovich. 2010. Climatic Influences on Dryland Salinity in Central West New South Wales, Australia. *Journal of Arid Environments* 74 (10): 1216–1224. https://doi.org/10.1016/j.jaridenv.2010.04.014.

Helsel D.R., and R.M. Hirsch. 2002. *Statistical Methods in Water Resources*, Techniques of Water Resources Investigations, Book 4, Chapter A3, 522. Reston: U.S. Geological Survey.

Holman, I.P. 2006. Climate Change Impacts on Groundwater Recharge-Uncertainty, Shortcomings, and the Way Forward? *Hydrogeology Journal* 14 (5): 637–647. https://doi.org/10.1007/s10040-005-0467-0.

Howard, J., and M. Merrifield. 2010. Mapping Groundwater Dependent Ecosystems in California. *Plos One* 5 (6). https://doi.org/10.1371/journal.pone.0011249.

Huntington, T.G. 2006. Evidence for Intensification of the Global Water Cycle: Review and Synthesis. *Journal of Hydrology* 319 (1–4): 83–95. https://doi.org/10.1016/j.jhydrol.2005.07.003.

IPCC. 2007. *Climate Change 2007-The Physical Science Basis: Working Group I Contribution to the Fourth Assessment Report of the IPCC*. vol. 4. Ed. S. Solomon. New York: Cambridge University Press.

Israel, M., and J.R. Lund. 1995. Recent California Water Transfers—Implications for Water Management. *Natural Resources Journal* 35 (1): 1–32.

Kanazawa, M. 2003. Origins of Common-Law Restrictions on Water Transfers: Groundwater Law in Nineteenth-Century California. *The Journal of Legal Studies* 32 (1): 153–180.

Klove, B., P. Ala-Aho, G. Bertrand, Z. Boukalova, A. Erturk, N. Goldscheider, and A. Widerlund. 2011a. Groundwater Dependent Ecosystems. Part I: Hydroecological Status and Trends. *Environmental Science & Policy* 14 (7): 770–781. https://doi.org/10.1016/j.envsci.2011.04.002.

Klove, B., A. Allan, G. Bertrand, E. Druzynska, A. Erturk, N. Goldscheider, and P. Schipper. 2011b. Groundwater Dependent Ecosystems. Part II. Ecosystem Services and Management in Europe Under Risk of Climate Change and Land Use Intensification. *Environmental Science & Policy* 14 (7): 782–793. https://doi.org/10.1016/j.envsci.2011.04.005.

Klove, B., M. Balderacchi, A. Gemitzi, S. Hendry, J. Kvaerner, T. Muotka, and E. Preda. 2014. Protection of Groundwater Dependent Ecosystems: Current Policies and Future Management Options. *Water Policy* 16 (6): 1070–1086. https://doi.org/10.2166/wp.2014.014.

Konikow, L.F. 2011. Contribution of Global Groundwater Depletion Since 1900 to Sea-Level Rise. *Geophysical Research Letters* 38. https://doi.org/10.1029/2011gl048604.

Konikow, L.F., and E. Kendy. 2005. Groundwater Depletion: A Global Problem. *Hydrogeology Journal* 13: 317–320. https://doi.org/10.1007/s10040-004-0411-8.

Koundouri, P. 2004. Current Issues in the Economics of Groundwater Resource Management. *Journal of Economic Surveys* 18 (5): 703–740. https://doi.org/10.1111/j.1467-6419.2004.00234.x.

Kundzewicz, Z.W., and P. Doll. 2009. Will Groundwater Ease Freshwater Stress Under Climate Change? *Hydrological Sciences Journal-Journal Des Sciences Hydrologiques* 54 (4): 665–675. https://doi.org/10.1623/hysj.54.4.665.

Lane, M.E., P.H. Kirshen, and R.M. Vogel. 1999. Indicators of Impacts of Global Climate Change on US Water Resources. *Journal of Water Resources Planning and Management-Asce* 125 (4): 194–204. https://doi.org/10.1061/(Asce)0733-9496(1999)125:4(194).

Lee, C.H. 1915. The Determination of Safe Yields of Underground Reservoirs of the Closed-Basin Type. *Transactions of the American Society of Civil Engineers* 79 (1): 148–218.

Levy, T.E. 1988. Ground Water Basin Management and Artificial Recharge. In *Artificial Recharge of Ground Water*, 455–464. New York: American Society of Civil Engineers.

Lindsey, B.D., and M.G. Rupert. 2012. Methods for Evaluating Temporal Groundwater Quality Data and Results of Decadal-Scale Changes in Chloride, Dissolved Solids, and Nitrate Concentrations in Groundwater in the United States, 1988–2010. *US Geological Survey Scientific Investigations Report* 5049 (2012): 46.

Lipson, A.J. 1978. *Efficient Water Use in California: The Evolution of Groundwater Management in Southern California*. Vol. 4. Santa Monica: Rand Corporation.

Liu, Y.Q., H. Gupta, E. Springer, and T. Wagener. 2008. Linking Science with Environmental Decision Making: Experiences from an Integrated Modeling Approach to Supporting Sustainable Water Resources Management. *Environmental Modelling & Software* 23 (7): 846–858. https://doi.org/10.1016/j.envsoft.2007.10.007.

Loaiciga, H.A., J.B. Valdes, R. Vogel, J. Garvey, and H. Schwarz. 1996. Global Warming and the Hydrologic Cycle. *Journal of Hydrology* 174 (1–2): 83–127. https://doi.org/10.1016/0022-1694(95)02753-X.

Loeltz, O.J., and S.A. Leake. 1979. *Relation Between Proposed Developments of Water Resources and Seepage from the All-American Canal, Eastern Imperial Valley, California*, 79–744. Tucson: US Geological Survey.

Lohman, S.W. 1972. *Ground-Water Hydraulics*, 70. Washington, DC: US Government Printing Office.

Mallory, M.J., L.A. Swain, and S.J. Tyley. 1980. *Potential for Using the Upper Coachella Valley Ground-Water Basin, California, for Storage of Artificially Recharged Water*, *80–599*. Menlo Park: US Geological Survey.

Mao, Y.X., B. Nijssen, and D.P. Lettenmaier. 2015. Is Climate Change Implicated in the 2013–2014 California Drought? A Hydrologic Perspective. *Geophysical Research Letters* 42 (8): 2805–2813. https://doi.org/10.1002/2015gl063456.

Margat, J., and J. Van der Gun. 2013. *Groundwater Around the World: A Geographic Synopsis*. Boca Raton: CRC Press.

McKee, T.B., N.J. Doesken, and J. Kleist. 1993. The Relationship of Drought Frequency and Duration to Time Scales. *Proceedings of the 8th Conference on Applied Climatology* 17 (22): 179–183. Boston: American Meteorological Society.

McKibben, M.A. 1993. The Salton Sea Trough Rift. In *Ashes, Faults and Basins*, San Bernardino County Museum Association Special Publications 93–1, ed. R.E. Reynolds and J. Reynolds, 76–80. Redlands: San Bernardino County Museum Association.

McMahon, T.A., and A.J.C. Adeloye. 2005. *Water Resources Yield*. Fort Collins: Water Resources Publications, LLC.

McMahon, P.B., K.F. Dennehy, B.W. Bruce, J.J. Gurdak, and S.L. Qi. 2007. *Water-Quality Assessment of the High Plains Aquifer, 1999–2004*. Reston: US Geological Survey.

Meinzer, O.E. 1923. *The Occurrence of Ground Water in the United States with a Discussion of Principles*. Vol. 484. Washington, DC: Government Print Office.

Mendenhall, W.C. 1909. *Ground Waters of the Indio Region, California, with a Sketch of the Colorado Desert*. Washington, DC: US Government Printing Office.

Moran, T., and A. Cravens. 2015. *California's Sustainable Groundwater Management Act of 2014: Recommendations for Preventing and Resolving Groundwater Conflicts*. Stanford: Water in the West, Stanford Woods Institute for the Environment.

MWH. 2012 *Coachella Valley Water Management Plan 2010 Update, (2015)*. 286

National Inventory of Dams. 2016. Washington, DC: US Army Corps of Engineers, Federal Emergency Management Agency. Accessible at http://nid.usace.army.mil.

Nelson, R.L. 2012. Assessing Local Planning to Control Groundwater Depletion: California as a Microcosm of Global Issues. *Water Resources Research* 48. https://doi.org/10.1029/2011wr010927.

Nishikawa, K., 2016. The End of an Era: California's First Attempt to Manage Its Groundwater Resources Through Its Sustainable Groundwater Management Act and Its Impact on Almond Farmers. *Environmental Claims Journal*, 28 (3): 206–222.

Palmer, W.C. 1965. *Meteorological Drought*. Vol. 30. Washington, DC: US Department of Commerce, Weather Bureau.

Pandey, V.P., S. Shrestha, S.K. Chapagain, and F. Kazama. 2011. A Framework for Measuring Groundwater Sustainability. *Environmental Science & Policy* 14 (4): 396–407. https://doi.org/10.1016/j.envsci.2011.03.008.

Patterson, L.J., N.C. Sturchio, B.M. Kennedy, M.C. van Soest, M. Sultan, Z.T. Lu, and A. Abdallah. 2005. Cosmogenic, Radiogenic, and Stable Isotopic Constraints on Groundwater Residence Time in the Nubian Aquifer, Western Desert of Egypt. *Geochemistry Geophysics Geosystems* 6. https://doi.org/10.1029/2004gc000779.

Pennink, J.M.K. 1905. Investigations for Groundwater Supplies. *Trans.-America Society of Civil Engineers* 54: 169–181.

Piechota, T., J. Timilsena, G. Tootle, and H. Hidalgo. 2004. The Western US Drought: How Bad Is It. *Eos 85* (32): 301–304.

Pillsbury, A.F. 1941. *Observations on Use of Irrigation Water in Coachella Valley, California*. Berkeley: University of California.

Poland, F. 1972. Land Subsidence in The Western States Due to Groundwater Overdraft. *JAWRA Journal of the American Water Resources Association* 8 (1): 118–131.

Prüss-Üstü, A., R. Bos, F. Gore, and J. Bartram. 2008. *Safer Water, Better Health: Costs, Benefits and Sustainability of Interventions to Protect and Promote Health*. Geneva: World Health Organization.

Reichard E.G., and J.K. Meadows. 1992. Evaluation of a Ground-Water Flow and Transport Model of the Upper Coachella Valley, California, *Water-Resources Investigations Report* 91–4142, 101. Sacramento, CA: *U.S.G.S.*

Richey, A.S., B.F. Thomas, M.H. Lo, J.S. Famiglietti, S. Swenson, and M. Rodell. 2015a. Uncertainty in Global Groundwater Storage Estimates in a Total Groundwater Stress Framework. *Water Resources Research* 51 (7): 5198–5216. https://doi.org/10.1002/2015wr017351.

Richey, A.S., B.F. Thomas, M.H. Lo, J.T. Reager, J.S. Famiglietti, K. Voss, and M. Rodell. 2015b. Quantifying Renewable Groundwater Stress with GRACE. *Water Resources Research* 51 (7): 5217–5238. https://doi.org/10.1002/2015wr017349.

———. 2016. Reply to Comment by Sahoo et al. on 'Quantifying Renewable Groundwater Stress with GRACE'. *Water Resources Research* 52 (5): 4188–4192. https://doi.org/10.1002/2015wr018329.

Rodell, M., H.K. Beaudoing, T.S. L'Ecuyer, W.S. Olson, J.S. Famiglietti, P.R. Houser, and E.F. Wood. 2015. The Observed State of the Water Cycle in the Early Twenty-First Century. *Journal of Climate* 28 (21): 8289–8318. https://doi.org/10.1175/Jcli-D-14-00555.1.

Sahoo, S., T. Russo, and U. Lall. 2016. Comment on 'Quantifying Renewable Groundwater Stress with GRACE' by Alexandra S. Richey et al. *Water Resources Research* 52 (5): 4184–4187. https://doi.org/10.1002/2015wr018085.

Sax, J.L. 2002. We Don't Do Groundwater: A Morsel of California Legal History. *University of Denver Water Law Review* 6: 269.

Scanlon, B.R., L. Longuevergne, and D. Long. 2012. Ground Referencing GRACE Satellite Estimates of Groundwater Storage Changes in the California Central Valley, USA. *Water Resources Research* 48. https://doi.org/10.1029/2011wr011312.

Scibek, J., and D.M. Allen. 2006. Modeled Impacts of Predicted Climate Change on Recharge and Groundwater Levels. *Water Resources Research* 42 (11). https://doi.org/10.1029/2005wr004742.

Seager, R., M.F. Ting, C.H. Li, N. Naik, B. Cook, J. Nakamura, and H.B. Liu. 2013. Projections of Declining Surface-Water Availability for the Southwestern United States. *Nature Climate Change* 3 (5): 482–486. https://doi.org/10.1038/Nclimate1787.

Shupe, S.J., G.D. Weatherford, and E. Checchio. 1989. Western Water Rights: The Era of Reallocation. *Natural Resources Journal* 29: 413.

Sneed M., and J.T. Brandt. 2013. *Detection and Measurement of Land Subsidence Using Global Positioning System Surveying and Interferometric Synthetic Aperture Radar, Coachella Valley, California, 1996–2005*, Scientific Investigations Report 2007–5251, 30. Reston: USGS.

Sneed M., S.V. Stork, and M.E. Ikehara. 2002. *Detection and Measurement of Land Subsidence Using Global Positioning System and Interferometric Synthetic Aperture Radar, Coachella Valley, California, 1998–2000*, Water-Resources Investigations Report 02–4239, 29. Sacramento, CA: USGS

Sneed, M., J. Brandt, and M. Solt. 2013. *Land Subsidence Along the Delta-Mendota Canal in the Northern Part of the San Joaquin Valley, California, 2003–10*. Reston: US Department of the Interior, US Geological Survey.

Sophocleous, M. 1997. Managing Water Resources Systems: Why "Safe Yield" Is Not Sustainable. *Ground Water* 35 (4): 561–561. https://doi.org/10.1111/j.1745-6584.1997.tb00116.x.

Stine, S. 1994. Extreme and Persistent Drought in California and Patagonia During Medieval Time. *Nature* 369 (6481): 546–549. https://doi.org/10.1038/369546a0.

Stine, S., and M. Stine. 1990. A Record from Lake Cardiel of Climate Change in Southern South-America. *Nature* 345 (6277): 705–708. https://doi.org/10.1038/345705a0.

Sturchio, N.C., X. Du, R. Purtschert, B.E. Lehmann, M. Sultan, L.J. Patterson, and A.M.A. Abdallah. 2004. One Million Year Old Groundwater in the Sahara Revealed by Krypton-81 and Chlorine-36. *Geophysical Research Letters* 31 (5). https://doi.org/10.1029/2003gl019234.

Swain, L.A. 1978. *Predicted Water-Level and Water-Quality Effects of Artificial Recharge in the Upper Coachella Valley, California, Using a Finite-Element Digital Model*, Water-Resources Investigations, 77–29. Menlo Park: USGS.

Syed, T.H., J.S. Famiglietti, D.P. Chambers, J.K. Willis, and K. Hilburn. 2010. Satellite-Based Global-Ocean Mass Balance Estimates of Interannual Variability and Emerging Trends in Continental Freshwater Discharge. *Proceedings of the National Academy of Sciences of the United States of America* 107 (42): 17916–17921. https://doi.org/10.1073/pnas.1003292107.

Tannehill, I.R. 1947. Drought, Its Causes and Effects. *Soil Science* 64 (1): 83.

Taylor, R.G., B. Scanlon, P. Doll, M. Rodell, R. van Beek, Y. Wada, and H. Treidel. 2013. Ground Water and Climate Change. *Nature Climate Change* 3 (4): 322–329. https://doi.org/10.1038/Nclimate1744.

Theis, C.V. 1940. The Source of Water Derived from Wells. *Civil Engineering* 10 (5): 277–280.

Thomas, B.F., and J.S. Famiglietti. 2015. Sustainable Groundwater Management in the Arid Southwestern US: Coachella Valley, California. *Water Resources Management* 29 (12): 4411–4426. https://doi.org/10.1007/s11269-015-1067-y.

Thomas, B.F., A. Behrangi, and J.S. Famiglietti. 2016a. Precipitation Intensity Effects on Groundwater Recharge in the Southwestern United States. *Water* 8 (3). https://doi.org/10.3390/w8030090.

Thomas, B.F., F.W. Landerer, D.N. Wiese, and J.S. Famiglietti. 2016b. A Comparison of Watershed Storage Trends Over the Eastern and Upper Midwestern Regions of the United States, 2003–2015. *Water Resour. Research*. Accepted Author Manuscript. https://doi.org/10.1002/2016WR018617

Tilman, D., K.G. Cassman, P.A. Matson, R. Naylor, and S. Polasky. 2002. Agricultural Sustainability and Intensive Production Practices. *Nature* 418 (6898): 671–677. https://doi.org/10.1038/nature01014.

Todd, D.K., and L.W. Mays. 2005. *Groundwater Hydrology*, 636. New York: John Wiley & Sons.

Trenberth, K.E. 2012. Framing the Way to Relate Climate Extremes to Climate Change. *Climatic Change* 115 (2): 283–290. https://doi.org/10.1007/s10584-012-0441-5.

Tyley, S.J. 1974. *Analog Model Study of the Ground-Water Basin of the Upper Coachella Valley, California*, Water-Supply Paper 2027, 77. Menlo Park: U.S.G.S.

Vorosmarty, C.J., and D. Sahagian. 2000. Anthropogenic Disturbance of the Terrestrial Water Cycle. *Bioscience* 50 (9): 753–765. https://doi.org/10.1641/0006-3568(2000)050[0753:Adottw]2.0.Co;2.

Vorosmarty, C.J., B.M. Fekete, M. Meybeck, and R.B. Lammers. 2000a. Global System of Rivers: Its Role in Organizing Continental Land Mass and Defining Land-to-Ocean Linkages. *Global Biogeochemical Cycles* 14 (2): 599–621. https://doi.org/10.1029/1999gb900092.

Vorosmarty, C.J., P. Green, J. Salisbury, and R.B. Lammers. 2000b. Global Water Resources: Vulnerability from Climate Change and Population Growth. *Science* 289 (5477): 284–288. https://doi.org/10.1126/science.289.5477.284.

Vorosmarty, C. J., P.B. McIntyre, M.O. Gessner, D. Dudgeon, A. Prusevich, P. Green, … P.M. Davies. 2010. Global Threats to Human Water Security and River Biodiversity. *Nature* 468(7321): 334–334. https://doi.org/10.1038/nature09549

Voss, K.A., J.S. Famiglietti, M.H. Lo, C. de Linage, M. Rodell, and S.C. Swenson. 2013. Groundwater Depletion in the Middle East from GRACE with Implications for Transboundary Water Management in the Tigris-Euphrates-Western Iran Region. *Water Resources Research* 49 (2): 904–914. https://doi.org/10.1002/wrcr.20078.

Wada, Y., L.P.H. van Beek, C.M. van Kempen, J.W.T.M. Reckman, S. Vasak, and M.F.P. Bierkens. 2010. Global Depletion of Groundwater Resources. *Geophysical Research Letters*: 37. https://doi.org/10.1029/2010gl044571.

Weatherford, G., K. Malcolm, and B. Andrews. 1982. California Groundwater Management: The Sacred and the Profane. *Natural Resources Journal* 22: 1031.

Williams, A.P., R. Seager, J.T. Abatzoglou, B.I. Cook, J.E. Smerdon, and E.R. Cook. 2015. Contribution of Anthropogenic Warming to California Drought During 2012–2014. *Geophysical Research Letters* 42 (16): 6819–6828. https://doi.org/10.1002/2015gl064924.

Woodhouse, C.A., S.T. Gray, and D.M. Meko. 2006. Updated Streamflow Reconstructions for the Upper Colorado River Basin. *Water Resources Research* 42 (5). https://doi.org/10.1029/2005wr004455.

Zhou, Y.X. 2009. A Critical Review of Groundwater Budget Myth, Safe Yield and Sustainability. *Journal of Hydrology* 370 (1–4): 207–213. https://doi.org/10.1016/j.jhydrol.2009.03.009.

5

America's Path to Drinking Water Infrastructure Inequality and Environmental Injustice: The Case of Flint, Michigan

Adrienne L. Katner, Kelsey Pieper, Yanna Lambrinidou, Komal Brown, Wilma Subra, and Marc Edwards

Background and Case Study

The recent drinking water crisis in Flint, Michigan (MI), highlighted problems associated with America's aging drinking water infrastructure. For years, the city had deferred investments in repairing and maintaining its water distribution system, due in large part to a collapsing economy and depopulation. In April of 2014, the city of Flint switched to a corrosive drinking water source, which in conjunction with a failure to implement corrosion control treatment (CCT) caused rampant infrastructure damage and corrosion-related health problems. This event has become known as a present-day exemplar of environmental injustice (Balazs and Ray 2014; VanDerslice 2011; Calow and Mason 2014; Greenberg 2016; Mantha 2016; Rabin 2008;

A. L. Katner (✉) • K. Brown
Louisiana State University- Health, New Orleans, LA, USA

K. Pieper • M. Edwards • Y. Lambrinidou
Virginia Tech University, Blacksburg, VA, USA

W. Subra
Louisiana Environmental Action Network, New Iberia, LA, USA

R. Brinkmann, S. J. Garren (eds.), *The Palgrave Handbook of Sustainability*,
https://doi.org/10.1007/978-3-319-71389-2_5

Stecker 2016; US EPA 2014; Edwards 2016a, b; Hanna-Attisha et al. 2016; Pieper et al. 2017), resulting in a doubling of childhood rates of elevated blood lead level (BLL) (Hanna-Attisha et al. 2016), and 91 confirmed cases of Legionellosis and 12 Legionellosis-related deaths (Schwake et al. 2016; Bouffard K. 2016; Anderson E. 2016; Ganim et al. 2016).

Lead exposure poses a significant public health risk, not just for individual consumers in terms of personal health and well-being but also for communities at large due to associated social and economic impacts. The toxic properties of lead have been known for more than 2400 years, when it was first documented by Vitruvius that water conducted by lead pipes had adverse health consequences (Hodge 1981). No safe blood lead level has been identified to date for infants and children (CDC 2005; ACCLPP 2012). Lead can cause permanent and irreversible damage to the developing nervous system—specifically, loss of gray matter in the prefrontal cortex, a part of the brain that controls aggression, emotion, impulses, attention, verbal reasoning, and mental flexibility (Cecil 2008). In 1991, it was estimated that drinking water could account for more than 85 percent of total lead exposure for formula-fed infants during a critical period of neurodevelopment (Federal Register 1991; AAP 2011). This is of concern, as waterborne lead is bioavailable, poses acute and chronic exposure risks, and has been associated with adverse health impacts, even at low levels (< 10 μg/L) (Deshommes and Prevost 2012; Triantafyllidou and Edwards 2011). Lead also bioaccumulates—childhood exposures have been associated with later life-effects, including renal problems, hypertension, reproductive problems, and developmental problems in offspring (ATSDR 2012). The consequences of behavioral, cognitive, and physical harm from childhood lead exposure are believed to cause societal and economic harm, such as increased violent crime, and costs to Americans in the range of $181–269 billion per year (Gould 2009; Nevin 2007; Feigenbaum and Muller 2016).

Another important potential public health impact related to older infrastructure is waterborne disease caused by opportunistic premise plumbing pathogens (OPPPs). OPPPs are waterborne pathogens which can flourish in household (or premise) plumbing. More waterborne disease outbreaks are now caused by OPPPs than traditional fecal-borne pathogens (Pruden et al. 2013). In fact, the one OPPP reported by health agencies tracking waterborne disease, *Legionella*, is responsible for most water-related disease outbreaks in the United States (US) (Pruden et al. 2013; Beer et al. 2015). In immunocompromised individuals, it can cause Legionnaires' disease, a deadly form of pneumonia with a hospitalization rate of 40 percent and fatality rate of >9 percent (CDC 2016; Dooling et al. 2015).

Lead and OPPPs serve as two of the most important water infrastructure-related public health problems of our time, and provide unique challenges to ensuring equitable delivery of clean and safe drinking water to all populations. Lead represents the oldest known human toxin, while OPPPs are a relatively recently discovered risk. The control of both of these hazards is a shared responsibility between water utilities and homeowners. Water utilities control the corrosivity of the water to reduce its ability to leach lead and its propensity to grow *Legionella*; but these problems tend to arise after the water passes across the private property line and into buildings. Both lead leaching and corrosivity are also suspected to be worsened by unlined iron water mains—iron can help mobilize lead from the downstream lead-bearing plumbing, can remove chlorine disinfectants, and is a known nutrient for *Legionella* (Masters and Edwards 2015; Wang et al. 2012, 2014, 2015; Masters et al. 2015). Hence, having unlined iron water mains in a community is no longer just creating aesthetic concerns with unsightly or distasteful red water, but this largely unregulated water contaminant is very likely adversely affecting the health of communities unable to replace this outdated infrastructure (Masters and Edwards 2015; Schwake et al. 2016).

The true extent of lead and OPPP problems are under-estimated due to monitoring and reporting weaknesses. Lead is ubiquitous in American water infrastructure. In the 1800s–1900s, cities across the US laid down millions of miles of lead service lines (LSLs) to connect water mains to individual homes (Troesken 2006). LSLs are considered the primary source of waterborne lead, contributing an estimated average of 50–75 percent of the total mass of lead at the tap when they are present (Sandvig et al. 2008). LSLs were banned nationally in 1986, but there are still an estimated 5.5–7.1 million LSLs serving 15–22 million Americans (Cornwell et al. 2016). Aside from LSLs, virtually all of today's housing stock contains lead-bearing plumbing. Lead was added to brass plumbing components through 2014; and it can be found in galvanized iron pipes, lead pipes, goosenecks, solder, and joints (Triantafyllidou and Edwards 2012). Waterborne lead has been regulated, since 1991, under the federal Lead and Copper Rule (LCR).[1] While water utilities are required to monitor tap water from high-risk homes, the US Environmental Protection Agency (US EPA) has acknowledged for over a decade that utilities collect samples in a manner that misses lead Action Level (AL) exceedances (15 parts per billion (ppb)) (Edwards and Dudi 2004; Del Toral et al. 2013; Gabler 2011; Milman and Glenza 2016). Yet, weaknesses in LCR sampling requirements, which are known but have never been addressed, have allowed cities with high lead in their water to meet regulatory requirements, even when health hazards were independently verified (Katner et al. 2016; Guyette 2015;

Flint Water Advisory Taskforce 2016). Such is the case in Flint, MI, when the city was officially meeting the LCR even in the midst of a Federal Emergency declared due to harm from high lead in water (Edwards 2016b). Reported LCR violations indicate the problem is widespread—in 2015 alone, 1110 US public water systems serving 3.9 million people exceeded the LCR lead level requirements (Olson and Fedinick 2016). The real number of system violations is likely higher as many utilities, especially small ones, regularly fail to monitor for water lead as required by the LCR. It is even harder to gauge the extent and severity of OPPP hazards, though, as neither monitoring nor reporting of OPPPs in premise water is required. This is, in part, due to the fact that the OPPP threat was only discovered in the last decade. To date, there is no systematic monitoring of premise systems for viable water pathogens like *Legionella*. This may be one reason for the slow association between Flint's water crisis and the city's spike in Legionnaires' disease that occurred shortly after Flint's switch in water supplies (Dawsey 2017). It is very clear that there was a strong association between Flint, Michigan's (MI) water supply switch (April 2014 to October 2015) and one of the worst outbreaks of Legionnaires' disease in US history (June 2014 to October 2015)—a majority of cases were traced to a single Flint, MI, hospital which had high levels of *Legionella* bacteria in its water supply (Schwake et al. 2016; Bouffard K. 2016; Anderson E. 2016; Ganim et al. 2016). Another challenge that prevents rapid identification and prevention of waterborne OPPP illnesses is the fact that Legionnaires' disease is frequently misdiagnosed and under-reported by hospitals. But while some hospitals do report Legionnaires' disease, other OPPP diseases such as non-tuberculosis mycobacterial infections are not reported at all.

The health and financial burdens that come from an inability to replace corroding iron and/or leaded water infrastructure, pipes, and premise plumbing give rise to a problem that we define herein as "water infrastructure inequality." Water infrastructure inequality (Edwards 2016a) acknowledges that communities who are unwilling or unable to pay for a modern water main or premise plumbing system may suffer adverse long-term health consequences or even higher death rates, as was documented in Flint, MI (Edwards 2016a; Pieper et al. 2017). In essence, the unfortunate citizens living in such communities are failing to reap the full benefits of one of the greatest public health achievements of the twentieth century attributable to water treatment and distribution (NRC 2003; Edwards 2015). This is, in part, due to twenty-first-century failures to invest in water infrastructure or to further their understanding of corrosion control (Edwards 2004a, b; Edwards et al. 2014). This situation gives rise to a widespread reality that

low-income communities are disproportionately burdened by corroding and failing drinking water infrastructure (which, for our purposes, includes all plumbing components through which water runs from the treatment plant to the tap, including water distribution mains, service lines, and premise plumbing). Water infrastructure inequality is exacerbated by population loss, such as that observed in post-industrial cities or rural America. Population loss, in turn, gives rise to steep increases in water rates, water shutoffs, system disuse, water stagnation, and metal leaching and pathogen growth, which produces declines in water quality and healthiness and increases in rates of corrosion (Edwards 2016a). Last line defenses such as in-home plumbing replacements, home treatment or filtration systems, or water deliveries may be too expensive for low-income individuals. All of these factors conspire to burden low-income communities with disproportionate exposures and health impacts. Waterborne lead and OPPPs are just two illustrative examples of the challenges posed by water infrastructure inequality, as illustrated by the Flint, MI, water disaster.

Lessons Learned

- The nation's aging and corroding water infrastructure is perpetuating inequality and environmental injustice.
- Sustained levels of action and creative financing strategies are needed to: (1) facilitate small system training and support; (2) share the cost of infrastructure replacements and improvements with struggling municipalities and low-income residents; and (3) increase support for state and federal monitoring, regulatory enforcement and oversight, and health surveillance and intervention.
- The role and authority of government should be broadened to pass on responsibility for full LSL replacements to government agencies.
- Regulations should be strengthened to authorize and incentivize full LSL replacement while ending partial LSL replacement under and outside the federal LCR. When these replacements are unavoidable, regulations should mandate minimization of galvanic corrosion and lead mobilization, issuance of public warnings, exposure prevention support, and full LSL replacement at the earliest time possible.
- Government enforcement mechanisms should be amended to control penalties on small systems while at the same time: (1) mandating changes in utility monitoring, documentation, and reporting; (2) increasing data, information, and government transparency; and (3) including the public

in the implementation and oversight of the LCR and in local, state, and federal decision-making about equitable access to safe water.
- Everyone, including public health and regulatory officials, should be educated about risks from leaded plumbing and OPPPs.

Challenges and Barriers

The lead-in-water crisis in Flint brought to the public's attention the disparate financial, health, and societal burdens that can be triggered by an aging water infrastructure, inadequate regulatory implementation and oversight, and attempts to save costs without also following best engineering practices or even federal law. Details related to Flint's water treatment deficiencies and regulatory oversight gaps are well-documented and can be found in greater detail elsewhere (Flint Water Advisory Task Force 2016). This section illustrates some of the challenges and barriers that are faced by residents of Flint and other towns facing similar water infrastructure challenges.

Socioeconomic Collapse

Flint suffered from what has been termed "an infrastructure death spiral" (Edwards 2016a). It is one of the poorest cities in the nation—40 percent of its 120,000 residents live in poverty, and a quarter of its population subsist on an annual income of less than $15,000 per year (ABC12 News Team 2015). Despite this, Flint was paying one of the highest water rates in the world when the lead exceedances were first discovered. Flint's population had declined by 40 percent since its peak in the 1960s, in part due to a rapid economic decline brought on by the collapse of America's automobile industry in the 1980s (Lee 2015), and perpetuated by America's mortgage crisis and subsequent recession between 2007 and 2009. These events trapped many residents who wanted to leave, but were not able to, as property values fell sharply (Dennis 2016a). The declining population used less water, which in turn contributed to water stagnation and system corrosion. Reduced revenue prevented infrastructure repairs, which triggered steep hikes in their water rates, and further population declines. As revenue dried up, a state-appointed financial manager switched Flint over to a more corrosive water supply. That decision was projected to save the city an estimated $5 million. State officials sanctioned this action, but at the same time, failed to enforce the LCR regulations requiring CCT. In 2015, independent testing confirmed that Flint was suffering from a system-wide drinking water contamination crisis.

Financial Burdens

The financial costs of addressing the Flint debacle currently seem insurmountable. It is widely acknowledged that the only sustainable long-term solution is full replacement of all corroding and leaded plumbing. But the cost for replacing Flint's entire water distribution system is estimated at $100–120 million (Wells 2016). To address this financial crisis, state and federal investment is needed (Livengood 2015). While Flint received more funding than other cities that have faced similar infrastructure disrepair, there has been no sustained federal investment or initiative to fully replace or repair water infrastructure on a national level to the extent needed. While the US EPA, Department of Agriculture, and Department of Housing and Urban Development does provide some funding, over 95 percent of spending in water infrastructure projects is from state and local governments (Walton 2016). Funds provided by the US EPA's Drinking Water State Revolving Fund (DWSRF) program are finite and are generally allocated in the form of loans which many small communities cannot afford to pay back. Since 1997, approximately $20 billion has been appropriated, but it could cost up to $30 billion for the United States to replace the remaining LSLs and $384 billion to ensure that all Americans are provided with safe drinking water (Tiemann 2016). If system expansion and population growth is considered, the costs could be as high as $1 trillion through 2035 to restore and expand systems (AWWA 2013). It is also important to remember that Flint's financial burdens are not limited to infrastructure replacement. There are also high costs associated with providing bottled water and care to affected residents, maintaining long-term health surveillance, and defending the government's actions in court (400 lawsuits to date) (Carmody 2016). Costs to address all of Flint's needs alone may amount to as much as $1.5 billion (Livengood 2016; Muennig 2016).

Infrastructure Responsibility

Private homeowners are frequently presented with legal challenges to overcome—in particular, LSL ownership and responsibility. In contrast to lead-bearing paint, toys, gasoline, and other lead sources, water infrastructure is the only source of lead that is, to some extent, government owned (i.e., publicly owned LSLs). But when faced with the financial implications of mass LSL replacements, many water utilities "gift" them to property owners. In a survey of 805 water utilities, 69 percent said they did not own any portion of existing LSLs (Kaplan and Hiar 2012). Gifting LSLs to property owners is one approach utilities use to shift ownership and responsibility for LSL

replacement onto homeowners. Given the fact that LSL replacements can cost as much as $8000 or more per house, the financial burden to low-income households is often one that cannot be overcome.

Partial Line Replacements

In 2004–2008, Washington, D.C., took measures to address its own historic lead-in-water contamination through an accelerated LSL replacement program. The city invested over $100 million to replace thousands of LSLs with copper. However, the majority of the replacements—approximately 85 percent—were "partial" (Stephenson 2008). Partial LSL replacements (PLSLRs) involve removal of only the portion of the LSL in public space (i.e., from the main in the street to the property line), typically considered publicly owned. The side of the LSL in private space is seen as the homeowner's responsibility and left intact, unless homeowners agree to pay for the replacement (which can range from a few hundred to several thousand dollars). Under certain circumstances, partial LSL replacements are known to increase water lead levels for days, weeks, months, or even years (Triantafyllidou and Edwards 2011; Edwards and Dudi 2004). This occurs because the act of changing out the line can disturb and mobilize protective scale and lead particles. In addition, the welding together of different metals can create an electrical connection that causes galvanic corrosion, which is what occurred in Washington, D.C. Consistent with prior warnings and testimony to Congress (Edwards and Dudi 2004; Edwards 2004a, b), the risk of elevated childhood BLLs increased in homes receiving partial LSL replacements, compared to that of homes with no LSLs, or homes with full LSL replacement (Brown et al. 2011; Brown 2009). In addition, a second spike in fetal death rates occurred between 2007 and 2009, shortly after and during the period of time when Washington, D.C., conducted PLSLRs (2004–2008).

Despite their known risks, partial LSL replacements continue to be required under the federal LCR. In practice, the vast majority of these replacements are carried out outside the authority of the LCR, in cities across the country, during routine water main work. An ethnographic investigation of homeowner decision-making concerning private side LSL replacement showed an increased likelihood of such replacement with higher income (Lambrinidou and Scott 2013). Although the finding is not surprising, it raises serious environmental justice and equity questions about the LCR. Indeed, one Flint lawsuit has questioned the notion that residents should bear the cost of LSL replacement on private property. This challenge rests on the fact that many

utilities installed LSLs at the direction or requirement of the municipality (Troesken 2006; Rabin 2008). Just as cities and states will need financial support from the federal government to replace corroding infrastructure, many homeowners will need financial support from cities and states to replace LSLs and leaded premise plumbing. A few cities have begun to move in this direction.

Sustainability of Short-Term Solutions

Until funding and legal challenges to long-term solutions are addressed, the state of Michigan is implementing several short-term solutions, which are not problem-free. Flint officials provided residents with bottled water. The monthly cost for this service was estimated at about $10.5 million, requiring state and federal funds as well as private donations (Scipioni 2016). Currently, emphasis is being placed on point-of-use (POU) water filters, but some residents question their effectiveness or report having difficulty accessing or correctly installing them (Rabin 2008). One humanitarian aid worker estimated that "…50 to 70 percent of folks we're seeing have filters that are not working" (Hullet 2016). Problems include broken filters, filter installation challenges, confusion about correct replacement cartridges, and overuse of filters past their expiration (Hullet 2016). In St. Joseph, LA, which has only recently come to national attention for its own lead-in-water contamination issues, filters don't work as expected, because they become clogged and are rendered useless within days or weeks following installation due to the high particulate content in their water (personal communication, Val Sloan 4/11/2016). This act highlights the reality that not all solutions will work for all systems.

Regulatory Gaps and Weaknesses in Regulatory Oversight and Enforcement

There is a need for regulatory reform through revisions to the federal LCR, as well as strengthening of regulatory oversight and enforcement (Lambrinidou 2015; Katner et al. 2016). At greatest risk are small systems with low-income populations. Utilities serving fewer than 50,000 consumers are not required to implement CCT unless they exceed the LCR's lead standard. Many utilities serving fewer than 3300 consumers are allowed to monitor for lead only once every nine years, while utilities serving fewer than 25 consumers and water from private drinking water wells are not regulated at all. When LCR violations occur,

government enforcement may or may not be implemented, and when it is implemented it may lack urgency or may trigger costly requirements that cause further hardship on utilities and offer little health protection to consumers (Ungar and Nichols 2016; Olson and Fedinick 2016). Such strategies for enforcement can be counterproductive. In Louisiana, for example, officials fined the East Mooringsport Water utility, which serves 800 people, more than $43,000 for not monitoring for lead, despite the fact that the reason behind the utility's failure was a lack of money (Ungar and Nichols 2016). In other cases, like Coal Mountain, West Virginia, state and federal notices, fines, and orders are simply ignored. Evidence suggests that when it comes to waterborne lead, government officials routinely cover up violations or take active steps to ignore or downplay actual and/or potential health harm (Edwards and Lambrinidou 2009; Leonnig 2004; Lombardo and Hall 2017; Telvock 2016).

Personal Costs and Environmental Injustice

Flint's crisis came with significant and tragic costs to both residents and the government. These costs are impossible to fully measure or reimburse. While the greatest impact is arguably the deaths associated with OPPPs after Flint's water switch, there will be life-long health problems experienced by lead-exposed children and adults as well as long-term socioeconomic impacts. Residents continue to struggle with worry and guilt over the health of their children, stress from financial strains, disturbing news reports and lawsuits, and loss in confidence and trust of their government and its solutions (Goodnough and Atkinson 2016).

Attention to Flint resulted largely from resident persistence, advocate support, media attention, and independent testing (Mantha 2016). This is argument enough for why there needs to be more robust public involvement, data transparency, government accountability, and public oversight of the LCR's implementation (Lambrinidou 2015). An independent Flint Task Force that investigated the Flint crisis determined that Flint "is a story of government failure, intransigence, unpreparedness, delay, inaction, and environmental injustice" (Flint Water Task Advisory 2016). The taskforce noted that the environmental injustice against Flint did not occur as a result of overt racist intentions, but rather from unequal protections and disparate impacts that are systemic and run counter to fundamental environmental justice principles, which are that "all communities…. enjoy the same degree of protection from environmental health hazards and equal access to the decision-making process …" (US EPA 2017). Flint's state-appointed financial manager replaced

local decision-makers, thus undermining democracy and removing "the checks and balances and public accountability that come with public decision-making" (Flint Water Task Advisory 2016). Government leaders were further implicated, in that they only offered "callous and dismissive responses to citizens' expressed concerns" (Flint Water Task Advisory 2016). The Task Force issued 44 recommendations. These included follow-up services, long-term health surveillance, and training and guidance on redressing and preventing environmental injustice in Flint.

Conclusions

America's corroding water infrastructure and leaded plumbing significantly impacts the safety of our drinking water, a substance we need for human survival (Edwards 2004b, 2014); and in the case of lead service lines, the source of lead is government owned and initiated (Troesken 2006). Planning and budgeting for replacement of our drinking water infrastructure and in-home leaded plumbing components must be prioritized, especially for low-income communities. It is estimated that 35.5 percent of US households will no longer be able to afford their water bills by 2022 (Mack and Wrase 2017); thus, steps must be taken to protect low-income and vulnerable populations. Any federal effort to systematically repair corroding infrastructure, and remove lead from systems and premise plumbing, would be complex and require decades-long investment and ongoing policy reform. But before moving forward, it is essential that proposed actions are evaluated critically within the context of historical warnings, failures, and successes, each system's unique water quality and infrastructure characteristics, as well as community composition and needs.

The issues faced in America could serve as a warning to other nations. Globally, 663 million people lack access to clean water affecting mostly the rural poor (UN 2015). While lead is perhaps one of the oldest and widely known water contaminants of concern, there are other new and re-emerging contaminants of concern, like OPPPs that must also be considered. Other worries are looming, including unmonitored and unregulated water contaminants (Dennis 2016b), water scarcity (Global Researcher 2008), and health impacts of unregulated water sources like private wells (Pieper et al. 2015). The relationship between our country's aging plumbing systems, inequality, and environmental injustice discussed in this chapter serves as a presage to the forthcoming challenges and disproportionate burdens that will continue

to be felt nationally and internationally, if the looming water infrastructure crisis and water infrastructure inequality is not addressed.

Note

1. In response to evidence of the ubiquity of lead in US drinking water, and documentation of low-dose impacts, the US federal government moved to control lead in water under the authority of the Safe Drinking Water Act (SDWA). Under SDWA authority, the US Environmental Protection Agency (US EPA) adopted the Lead and Copper Rule (LCR) (Federal Register 1991). This Rule requires that utilities sample tap water from high-risk homes to evaluate lead and copper levels, and corrosion control treatment (CCT). It required that no more than ten percent of samples could exceed the lead Action Level (AL) of 15 parts per billion (ppb) or micrograms per liter (μg/L). When >10 percent of samples exceed the lead AL, utilities are required to implement corrective actions, including optimization of CCT to reduce water corrosivity, and replacement of at least seven percent of the distribution system's LSLs annually, until the utility comes back into compliance or until all LSLs are replaced.

References

ABC12 News Team. 2015. Flint Is Now the Second Most Poverty-Stricken City in the Nation. *ABC12.com*, September 18. http://www.abc12.com/home/headlines/Flint-is-now-the-second-most-poverty-stricken- city-in-the-nation-328164611.html. Accessed 7 Jan 2017.

Advisory Committee on Childhood Lead Poisoning Prevention (ACCLPP). 2012. *Low Level Lead Exposure Harms Children: A Renewed Call for Primary Prevention*. Atlanta: US Department of Health and Human Services, CDC, ACCLPP. https://www.cdc.gov/nceh/lead/acclpp/final_document_030712.pdf. Accessed 2 Jan 2017.

Agency for Toxic Substances and Disease Research (ATSDR). 2012. *Lead Toxicity: What Are the Physiological Effects of Lead Exposure?* August 20. https://www.atsdr.cdc.gov/csem/csem.asp?csem=7&po=10. Accessed 28 Jan 2017.

American Academy of Pediatrics (AAP). 2011. Letter from American Academy of Pediatrics to Aaron Yeow of EPA. *EPA*, March 22. https://yosemite.epa.gov/sab/sabproduct.nsf/177871EFC7607CD08525785C0050AAB1/$File/aapcomments.PDF. Accessed 7 Jan 2017.

American Water Works Association (AWWA). 2013. *Buried No Longer: Confronting America's Water Infrastructure Challenge*. http://www.awwa.org/Portals/0/files/legreg/documents/BuriedNoLonger.pdf. Accessed 31 Jan 2017.

Anderson, E. 2016. Legionnaires-Associated Deaths Grow to 12 in Flint Area. *Detroit Free Press*, April 11. http://www.freep.com/story/news/local/michigan/flint-water-crisis/2016/04/11/legionnaires-deaths-flint-water/82897722/. Accessed 7 Jan 2017.

Balazs, C., and I. Ray. 2014. Drinking Water Disparities Framework: On the Origins and Persistence of Inequities in Exposure. *American Journal of Public Health* 104 (4): 603–611.

Beer, K.D., J.W. Gargano, V.A. Roberts, V.R. Hill, L.E. Garrison, P.K. Kutty, E.D. Hilborn, T.J. Wade, K.E. Fullerton, and J.S. Yoder. 2015. "Surveillance for Waterborne Disease Outbreaks Associated with Drinking Water" – United States, 2011–2012. *CDC Morbidity and Mortality Weekly Report* 64: 842–848.

Bouffard, K. 2016. Hospital Ties Legionnaires' to Flint water. *The Detroit News*, January 22. http://www.detroitnews.com/story/news/politics/2016/01/22/legionnaires-bacteria-found-tests-mclaren-medical-centers-water/79183428/. Accessed 28 Jan 2017.

Brown, M.J. 2009. Letter from Mary Jean Brown to Avis Russell, Interim General Manager, DC WASA. cc'd to *District Department of Environment and Environmental Protection Agency's Office of Water*. September 4.

Brown, M.J., J. Raymond, D. Homa, C. Kennedy, and T. Sinks. 2011. Association Between Children's Blood Lead Levels, Lead Service Lines, and Water Disinfection, Washington, DC, 1998–2006. *Environmental Research* 111 (1): 67–74.

Calow, R., and N. Mason. 2014. The Real Water Crisis: Inequality in a Fast Changing World. *Overseas Development Institute*. https://www.odi.org/sites/odi.org.uk/files/odi-assets/publications-opinion-files/8953.pdf. Accessed 7 Jan 2017.

Carmody, S. 2016. Gov. Snyder's Sweeping Plan for Flint Water Crisis Gets a Reality Check. *NPR.org*, March 26. http://www.npr.org/2016/03/26/471938610/gov-snyders-sweeping-plan-for-flint-water-crisis-gets-a-reality-check. Accessed 7 Jan 2017.

Cecil, K. 2008. Decreased Brain Volume in Adults with Childhood Lead Exposure. *PLOS Medicine*. https://doi.org/10.1371/journal.pmed.0050112. Accessed 7 Jan 2017.

Centers for Disease Control and Prevention (CDC). 2005. *Preventing Lead Poisoning in Young Children*. Atlanta: U.S. Department of Health and Human Services. https://www.cdc.gov/nceh/lead/Publications/PrevLeadPoisoning.pdf. Accessed 5 June 2016.

Cornwell, D.A., R.A. Brown, and S.H. Via. 2016. National Survey of Lead Service Line Occurrence. *Journal of the American Water Works Association* 108 (4): E182–E191.

Dawsey C.P. 2017. Soaring Pneumonia Deaths in Genesee County Likely Linked to Undiagnosed Legionnaires', Experts Say. The Center for Michigan. *Bridge*. http://www.bridgemi.com/children-families/soaring-pneumonia-deaths-genesee-county-likely-linked-undiagnosed-legionnaires. Accessed 28 Jan 2017.

Del Toral, M., A. Porter, and M. Schock. 2013. Detection and Evaluation of Elevated Lead Release from Service Lines: A Field Study. *Environmental Science & Technology* 47 (16): 9300–9307.

Dennis, B. 2016a. 'If I Could Afford to Leave, I Would.' In Flint, a Water Crisis with No End in Sight. *Washingtonpost.com*, October 22. https://www.washingtonpost.com/national/health-science/if-i-could-afford-to-leave-i-would-in-flint-a-water-crisis-with-no-end-in-sight/2016/10/21/4d42f2f0-953c-11e6-9b7c-57290af48a49_story.html?utm_term=.6f546fc3aeda. Accessed 7 Jan 2017.

———. 2016b. In U.S. Drinking Water, Many Chemicals Are Regulated – But Many Aren't. *Washingtonpost.com*. https://www.washingtonpost.com/national/health-science/in-us-drinking-water-many-chemicals-are-regulated--but-many-arent/2016/06/09/e48683bc-21b9-11e6-aa84-42391ba52c91_story.html?utm_term=.062bd0becbbc. Accessed 7 Jan 2017.

Deshommes, E., and M. Prevost. 2012. Pb Particles from Tap Water: Bioaccessibility and Contribution to Child Exposure. *Environmental Science and Technology* 46 (11): 6269–6277.

Dooling, K.L., K. Toews, L.A. Hicks, L.E. Garrison, B. Bachaus, S. Zansky, R. Carpenter, B. Schaffner, E. Parker, S. Petit, et al. 2015. "Active Bacterial Core Surveillance for Legionellosis" — United States, 2011—2013. *CDC Morbidity and Mortality Weekly Report* 64 (42): 1190–1193.

Edwards, M. 2004a. Testimony to the 108th Congress of the United States. Lead in DC Drinking Water. House Committee on Government Reform, 5 March 2009. 29 pages.

———. 2004b. Designing Sampling for Targeting Lead and Copper: Implication for Exposure. Webinar to the *US EPA National Drinking Water Advisory Council for Lead and Copper*. http://flintwaterstudy.org/2016/01/lead-in-drinking-water-101/. Accessed 29 Jan 2017.

———. 2014. Fetal Death and Reduced Birth Rates Associated with Exposure to Lead Contaminated Drinking Water. *Environmental Science and Technology* 48 (1): 739–746.

———. 2015. Corrosion Control in Water Distribution Systems: One of the Grand Engineering Challenges for the 21st Century. Edited by Simon Parsons, Richard Stuetz, Bruce Jefferson and Marc Edwards. *Water Science and Technology* 49 (2): 1–8.

———. 2016a. Understanding Flint's Water Infrastructure Crisis: Water Infrastructure Inequality in America. *Flintwaterstudy.org*, December 9. http://flintwaterstudy.org/2016/12/understanding-flints-water-infrastructure-crisis-water-infrastructure-inequality-in-america/. Accessed 7 Jan 2017.

———. 2016b. Contaminated Drinking Water in Flint [February 2016]. Congressional Hearings on Flint Water Crisis. http://flintwaterstudy.org/2016/02/congressional-hearings-on-flint-water-crisis-february-2016/. Accessed 29 Jan 2017.

Edwards, M., and A. Dudi. 2004. Role of Chlorine and Chloramine in Corrosion of Lead-Bearing Plumbing Materials. *Journal of American Water Works Association* 96 (10): 69–81.

Edwards, M., and Y. Lambrinidou. 2009. Institutional Scientific Misconduct at U.S. Public Health Agencies: How Malevolent Government Betrayed Flint, MI. *Oversight and Government Reform*. https://oversight.house.gov/wp-content/uploads/2016/02/Edwards-VA-Tech-Statement-2-3-Flint-Water.pdf. Accessed 7 Jan 2017.

Edwards, M., W.J. Rhoads, A. Pruden, A. Pearce, and J.O. Falkinham III. 2014. Green Water Systems and Opportunistic Premise Plumbing Pathogens: The Grand Challenge of Meeting Water and Energy Sustainability Goals Without Endangering Public Health. *Plumbing Engineer* (November): 63–65.

Federal Register. 1991. EPA. Maximum Contaminant Level Goals and National Primary Drinking Water Regulations for Lead and Copper; Final Rule. *Federal Register,* 56 FR 26460, 40 CFR Part 141, Subpart I. June 7

Feigenbaum, J., and C. Muller. 2016. *Lead Exposure and Violent Crime in the Early Twentieth Century*. Harvard University. http://scholar.harvard.edu/files/jfeigenbaum/files/feigenbaum_muller_lead_crime.pdf. Accessed 7 Jan 2017.

Flint Water Advisory Task Force. 2016. *Flint Water Task Force Final Report*. https://www.michigan.gov/documents/snyder/FWATF_FINAL_REPORT_21March2016_517805_7.pdf. Accessed 8 Jan 2017.

Gabler, E. 2011. High Lead Levels Found in Chicago Water. *Chicago Tribune*, August 5.http://www.chicagotribune.com/lifestyles/health/ct-met-lead-in-water-20110805-story.html. Accessed 28 Jan 2017.

Ganim, S., L. Tran, and M. Simon. 2016. Exclusive: Michigan Legionnaires' Deaths Were Preventable, Official Says. *CNN.com*, February 12. http://www.cnn.com/2016/02/12/us/flint-michigan-legionnaires/. Accessed 7 Jan 2017.

Global Researcher. 2008. Looming Water Crisis. *GlobalResearcher.com*, 2(2): pp. 27–56. http://www.perc.org/sites/default/files/water%20global%20researcher.pdf. Accessed 29 Jan 2017.

Goodnough, A., and S. Atkinson. 2016. A Potent Side Effect to the Flint Water Crisis: Mental Health Problems. *NYTimes.com*, April 30. http://www.nytimes.com/2016/05/01/us/flint-michigan-water-crisis-mental-health.html?_r=1. Accessed 7 Jan 2017.

Gould, E. 2009. Childhood Lead Poisoning: Conservative Estimates of the Social and Economic Benefits of Lead Hazard Control. *Environmental Health Perspective* 117 (7): 1162–1167.

———. 2016. Delivering Fresh Water: Critical Infrastructure, Environmental Justice, and Flint, Michigan. *American Journal of Public Health* 106 (8): 1358–1360.

Guyette, C. 2015. Scary: Leaded Water and One Flint Family's Toxic Nightmare. *Deadline Detroit.* http://www.deadlinedetroit.com/articles/12697/scary_leaded_water_and_one_flint_family_s_toxic_nightmare#.VbLvmvlViko. Accessed 28 Jan 2017.

Hanna-Attisha, M., J. LaChance, R.C. Sadler, and A.C. Schnepp. 2016. Elevated Blood Lead Levels in Children Associated with the Flint Drinking Water Crisis: A Spatial Analysis of Risk and Public Health Response. *American Journal of Public Health* 106 (2): 283–290.

Hodge, A.T. 1981. Vitruvius, Lead Pipes and Lead Poisoning. *American Journal of Archaeology* 85 (4): 486.

Hullet, S. 2016. In Flint, Trust in Filters – And Government – Elusive. *Michiganradio.com*, June 30. http://michiganradio.org/post/flint-trust-filters-and-government-elusive. Accessed 7 Jan 2017.

Kaplan, S., and C. Hiar. 2012. How an EPA Project Backfired, Endangering Drinking Water with Lead. *NBCNews.com*, August 8. http://investigations.nbcnews.com/_news/2012/08/08/13179335-how-an-epa-project-backfired-endangering-drinking-water-with-lead. Accessed 8 Jan 2017.

Katner, A., K.J. Pieper, L. Lambrinidou, K. Brown, C. Hu, H.W. Mielke, and M.A. Edwards. 2016. Weaknesses in Federal Drinking Water Regulations and Public Health Policies that Impede Lead Poisoning Prevention and Environmental Justice. *Environmental Justice* 9 (4): 109–117.

Lambrinidou, Y. 2015. *Long-Term Revisions for the Lead and Copper Rule (LCR) [Letter of Dissent to the National Drinking Water Advisory Council (NDWAC)]*. https://www.epa.gov/sites/production/files/2015-11/documents/ndwaclcrstatementofdissent.pdf.

Lambrinidou, Y., and R. Scott. 2013. Empirical and Legal Evaluation of Public Health Protection Under the Federal Lead and Copper Rule: Qualitative Research (Preliminary Findings). Invited Presentation at Robert Wood Johnson Foundation, Public Health Law Research Annual Grantee Meeting "Making the Case for Laws that Improve Health," New Orleans, LA. January 16–18.

Lee, T. 2015. The Rust Belt: Once Mighty Cities in Decline. *MSNBC.com*. http://www.msnbc.com/interactives/geography-of-poverty/ne.html. Accessed 7 Jan 2017.

Legionella: Legionnaires Disease and Pontiac Fever. CDC. 2016. https://www.cdc.gov/legionella/index.html. Accessed 28 Jan 2017.

Leonnig, C.D., J. Becker, and D. Nakamura. 2004. Lead Levels in Water Misrepresented Across the U.S.: Utilities Manipulate or Withhold Test Results to Ward off Regulators. *Washington Post.* http://www.washingtonpost.com/wp-dyn/articles/A7094-2004Oct4.html. Accessed 23 Feb 2018.

Livengood, C. 2015. Loan Forgiveness Sought for Flint to Replace Lead Pipes. *Detroitnews.com*, December 6. http://www.detroitnews.com/story/news/politics/2015/12/06/loan-forgiveness-sought-flint-replace-lead-pipes/76845170/. Accessed 7 Jan 2017.

Livengood, C. 2016. Flint Mayor: Water Fix Could Cost as much as $1.5B. *Detroitnews.com,* January 7. http://www.detroitnews.com/story/news/politics/2016/01/07/flint-water/78404218/. Accessed 7 Jan 2017.

Lombardo, C., and D.J. Hall. 2017. DNR and Milwaukee Leaders Agree: Wisconsin Must Do More About Lead in Drinking Water. *Wisconsin Center for Investigative Journalism*, January 13. http://host.madison.com/ct/news/local/govt-and-politics/dnr-and-milwaukee-leaders-agree-wisconsin-must-do-more-about/article_bc19d4fc-5804-594b-843d-c096d6218936.html. Accessed 31 Jan 2017.

Mack, E.A., and S. Wrase. 2017. A Burgeoning Crisis? A Nationwide Assessment of the Geography of Water Affordability in the Unites States. *PLoS ONE* 12 (1): e0169488. https://doi.org/10.1371/journal.pone.0169488. Accessed 30 Jan 2017.

Mantha, A. 2016. Clean Water for St. Joseph, LA: A Victory in the Battle Against Infrastructure Inequality. *Flintwaterstudy.org*, December 17. http://flintwaterstudy.org/2016/12/clean-water-for-st-joseph-la-a-victory-in-the-battle-against-infrastructure-inequality/. Accessed 7 Jan 2017.

Masters, S., and M. Edwards. 2015. Increased Lead in Water Associated with Iron Corrosion. *Environmental Engineering Science* 32 (5): 361–369.

Masters, S.M., H. Wang, A. Pruden, and M. Edwards. 2015. Redox Gradients in Distribution Systems Influence Water Quality, Corrosion, and Microbial Ecology. *Water Research* 68: 140–149. https://doi.org/10.1016/j.watres.2014.09.048.

Milman, O., and J. Glenza. 2016. At Least 33 Cities Used Water Testing 'Cheats' Over Lead Concerns. *The Guardian*, June 2. https://www.theguardian.com/environment/2016/jun/02/lead-water-testing-cheats-chicago-boston-philadelphia. Accessed 29 Jan 2017.

Muennig, P. 2016. The Social Costs of Lead Poisoning. *Health Affairs* 35 (8): 1545. https://doi.org/10.1377/hlthaff.2016.0661.

National Research Council (NRC). 2003. *A Century of Innovation: Twenty Engineering Achievements that Transformed Our Lives*. Washington, DC: The National Academies Press. https://doi.org/10.17226/10726.

Nevin, R. 2007. Understanding International Crime Trends: The Legacy of Preschool Lead Exposure. *Environmental Research* 104: 315–336.

Olson, E., and K.P. Fedinick. 2016. *What's in Your Water? Flint and Beyond.* National Resource Defense Council (NRDC). https://www.nrdc.org/sites/default/files/whats-in-your-water-flint-beyond-report.pdf. Accessed 7 Jan 2017.

Pieper, K., L.H. Krometis, D.L. Gallagher, B.L. Benham, and M. Edwards. 2015. Incidence of Waterborne Lead in Private Drinking Water Systems in Virginia. *Journal of Water and Health* 13 (3): 897–908.

Pieper, K.J., M. Tang, and M.A. Edwards. 2017. Flint Water Crisis Caused by Interrupted Corrosion Control: Investigating "Ground Zero" Home. *Environmental Science and Technology* 51 (4): 2007–2014.

Pruden, A., M.A Edwards, and J.O. Falkinham. 2013. *State of the Science and Research Needs for Opportunistic Pathogens in Premise Plumbing*. Denver: Water Research Foundation (WRF). http://www.waterrf.org/PublicReportLibrary/4379.pdf. Accessed 28 Jan 2017.

Rabin, R. 2008. The Lead Industry And Lead Water Pipes: 'A Modest Campaign'. *American Journal of Public Health* 98 (9): 1584–1592.

Sandvig, A. M., P. Kwan, G. Kirmeyer, B. Maynard, D. Mast, R.R. Trussell, S. Trussell, A. Cantor, and A. Prescott. 2008. *Contribution of Service Line and Plumbing Fixtures to Lead and Copper Rule Compliance Issues*. Denver: American Water Works Research Foundation (AWWaRF). https://archive.epa.gov/region03/dclead/web/pdf/91229.pdf. Accessed 7 Jan 2017.

Schwake, D.O., E. Garner, O.R. Strom, A. Pruden, and M.A. Edwards. 2016. *Legionella* DNA Markers in Tap Water Coincident with a Spike in Legionnaire's Disease in Flint, MI. *Environmental Science and Technology* 3 (9): 311–315.

Scipioni, J. 2016. Is the Flint Water Crisis Getting Worse? *Foxbusiness.com*, December 5. http://www.foxbusiness.com/features/2016/12/05/is-flint-water-crisis-getting-worse.html. Accessed 7 Jan 2017.

Stecker, T. 2016. Federal Law Makes Lead-Pipe Removal Anything but a Cinch. *E&E News*, July 7. http://www.eenews.net/stories/1060039790. Accessed 7 Jan 2017.

Stephenson, J.B. 2008. *The District of Columbia and Communities Nationwide Face Serious Challenges in Their Efforts to Safeguard Water Supplies, GAO-08-687T*. Washington, DC: Government Accountability Office (GAO).

Telvock, D. 2016. Looking for Lead (In All the Wrong Places: How Disparity, 'Cheating' and Potential Conflicts Plague Buffalo's Sampling Program for Lead in Drinking Water. *Investigative Post*. http://interactive.investigativepost.org/lead-buffalo-2016/. Accessed 31 Jan 2017.

Tiemann, M. 2016. *Drinking Water State Revolving Fund (DWSRF): Program Overview and Issues*. Federation of American Scientists. https://fas.org/sgp/crs/misc/RS22037.pdf. Accessed 7 Jan 2017.

Triantafyllidou, Y., and M. Edwards. 2011. Galvanic Corrosion After Simulated Small-Scale Partial Lead Service Line Replacements. *Journal of American Water Works Association* 103 (9): 85–99.

Triantafyllidou, S., and M. Edwards. 2012. Lead (Pb) in Tap Water and in Blood: Implications for Lead Exposure in the United States. *Critical Review of Environmental Science and Technology* 42 (13): 1297–1352.

Troesken, W. 2006. *The Great Lead Water Pipe Disaster*. Cambridge, MA: MIT Press.

Ungar, L., and M. Nichols. 2016. 4 Million Americans Could Be Drinking Toxic Water and Would Never Know. *USAToday.com*, December 13. http://www.usatoday.com/story/news/2016/12/13/broken-system-means-millions-of-rural-americans-exposed-to-poisoned-or-untested-water/94071732/. Accessed 7 Jan 2017.

United Nations (UN). 2015. *Progress on Sanitation and Drinking Water: 2015 Update and MDG Assessment*. WHO/UNICEF, UN. http://www.who.int/water_sanitation_health/publications/jmp-2015-update/en/.

US Environmental Protection Agency (US EPA). 2014. U.S. EPA NDWAC Lead and Copper Working Group. *EPA*, November 11–12. https://www.epa.gov/sites/production/files/2015-11/documents/lcrwgmeetsummarynov2014.pdf. Accessed 7 Jan 2017.

———. 2017. *Learn About Environmental Justice*. [online] Available at: https://www.epa.gov/environmentaljustice/learn-about-environmental-justice. Accessed 2 Feb 2018.

VanDerslice, J. 2011. Drinking Water Infrastructure and Environmental Disparities: Evidence and Methodological Considerations. *American Journal of Public Health* 101 (S1): 109–114.

Walton, B. 2016. Water System Needs Investment and Affordability. *Circleofblue.org*. http://www.circleofblue.org/2016/water management/infrastructure/water-systems-need-investment-affordability/. Accessed 7 Jan 2017.

Wang, H., S. Masters, Y. Hong, J. Stallings, J.O. Falkingham, M. Edwards, and A. Pruden. 2012. Effect of Disinfectant, Water Age, and Pipe Material on Occurrence and Persistence of *Legionella*, Mycobacteria, *Pseudomonas aeruginosa*, and Two Amoebas. *Environmental Science & Technology* 46 (21): 11566–11574.

Wang, H., S. Masters, M.A. Edwards, J.O. Falkinham III, and A. Pruden. 2014. Effect of Disinfectant, Water Age, and Pipe Materials on Bacterial and Eukaryotic Community Structure in Drinking Water Biofilm. *Environmental Science & Technology* 48: 1426–1435. https://doi.org/10.1021/es402636u.

Wang, H., S. Masters, J.O. Falkinham, M. Edwards, and A. Pruden. 2015. Distribution System Water Quality Affects Responses of Opportunistic Pathogen Gene Markers in Household Water Heaters. *Environmental Science & Technology* 9 (14): 8416–8424. https://doi.org/10.1021/acs.est.5boa.538.

Wells, K. 2016. Flint's Water System Is Falling Apart. Fixing It Could Cost $100 Million. *Michiganradio.org*, August 9. http://michiganradio.org/post/flints-water-system-falling-apart-fixing-it-could-cost-100-million#stream/0. Accessed 8 Jan 2017.

6

Sustainable Renewable Energy: The Case of Burlington, Vermont

Sandra J. Garren

Background

In the United States (US), public discourse supporting energy independence can be traced back to 1949 when for the first time in American history oil imports exceeded oil exports (US IEA 2012). In response, national policy quickly shifted toward increasing domestic oil and gas production (Green and Liu 2015), advancing energy efficiency (Dixon et al. 2010), and transitioning toward alternative and renewable energy sources (El-Ashry 2012). In the 1970s, energy independence rhetoric was reignited during the Organization of the Petroleum Exporting Countries (OPEC) oil embargo (Jacobs 2016). In addition to energy independence, transitioning to renewable energy has been heralded as the solution to avert the negative impacts from climate change since burning fossil fuels is the principal driver of climate change. In the US, burning fossil fuels represented approximately 82 percent of all greenhouse gas emissions (GHGs) in 2016 (US EPA 2017).

Even though the message of energy independency and climate change has been called for over the last 65 years, the shift toward renewable energy has not significantly increased. In 2016, the US still sources 80.7 percent of its energy from fossil fuels (US EIA 2017). Another 8.6 percent of energy is from nuclear, and only 10.4 percent is from renewable energy sources (US EIA

S. J. Garren (✉)
Geology, Environment, and Sustainability, Hofstra University, Hempstead, NY, USA

R. Brinkmann, S. J. Garren (eds.), *The Palgrave Handbook of Sustainability*,
https://doi.org/10.1007/978-3-319-71389-2_6

2017). The reasons behind the ineffectual movement away from fossil fuels and toward renewable energy have been attributed to a number of economic factors, a lack of social acceptance, and a scarcity of political will (Abotah and Daim 2017). To add to these reasons, energy subsidies continue to favor fossil fuels even though "many subsidies serve almost no discernible public good – and in some ways – can do considerable bad" (Sovacool et al. 2014, 151).

The US does not have a far-reaching, comprehensive energy and climate plan but instead has a long history of siloed energy policy that mostly favors the continued use of fossil fuels. It is in this void of national policy that US state and local governments have taken the lead in promoting energy efficiency and renewable energy. State policies that promote renewable energy include providing public benefit funds, developing renewable portfolio standards (RPS), and providing tax incentives (Cheng and Yi 2017). An RPS is a statewide policy that requires a specific percentage of energy to be supplied by renewable resources, and to date, 29 states currently have an RPS (NCSL 2017). According to Vassar (2016), states that are affluent and have a high density of environmental groups and lack fossil fuel production are predictors of strong renewable energy policy. Two states that meet these criteria include California and New York, and it is no surprise that these states lead the country in energy policy. Each of these states has a long history of codified renewable energy and energy efficiency policies. For example, both states have a target to supply half of their electricity from renewable sources by 2030 (California Energy Commission 2017; New York State n.d.).

In addition to state governments, local governments have also become global leaders that have advanced aggressive policies aimed at transitioning municipalities to renewable energy and reduce GHG emissions. As of June 2017, 36 US cities have pledged to source 100 percent of electrical power from renewable energy, and five cities have already achieved this target (i.e., Aspen, Colorado; Burlington, Vermont; Greensburg, Kansas; Kodiak, Alaska; and Rock Port, Missouri) (Sierra Club 2017). With relatively little fanfare, Burlington, Vermont, became the first American city to source 100 percent of its electrical energy from renewable energy (Peters 2015). But it is worth noting that in 2008, Rock Port, Missouri, which had a population at the time of approximately 1000 people, became the first community to be powered 100 percent from wind (Science News 2008). If all 36 cities that have formally pledged to transition toward renewable energy achieve their goal, an additional 15 gigawatts (GWs) of new renewable energy would be added to the grid. In addition to the 36 cities, over 100 mayors have publicly supported the 100 percent goal through the 100+ mayors for clean energy initiative, and 1481 mayors have signed onto the US Conference of Mayors Compact to

support reductions in GHG emissions. If all the cities in the compact take action, an additional 422 GWs of new renewable energy would be added to the US energy supply (Sierra Club 2017).

Many may know Burlington as the home of socially conscious Ben & Jerry's ice cream and the gateway to Vermont's expansive outdoor activities which is a 5.5 billion-dollar industry (OIA 2017). However, Burlington, Vermont's achievement as the first city to achieve 100 percent renewable electricity is the topic of this chapter. Along with its renewable energy success, its unique political composition, and a diversified energy portfolio (i.e., biomass, hydroelectricity, wind, and solar), this small city in the Green Mountain state offers many lessons to be learned as well as highlights a number of continued challenges as Burlington works toward its new ten-year goal of becoming a net zero city (BED 2016a). It is for these reasons that Burlington was chosen to be highlighted in this collection of case studies from around the world.

The Case of Burlington, Vermont

About Burlington, Vermont

The City of Burlington, Vermont, is located on the eastern shore of Lake Champlain near the Canadian border (Fig. 6.1). In 2016, Burlington's population was 42,260 (US Census 2016). Even with this relatively low population, Burlington is the most populated city in the state representing approximately seven percent of the state's population. The City of Burlington and neighboring City of South Burlington are the principal cities in the Burlington Metropolitan Area which encompass all of Chittenden, Franklin, and Grand Isle Counties (US Census 2010) (Fig. 6.1). The metropolitan area has a combined population of over 200,000 people which is roughly a third of the state's population of 624,594. The city is primarily Caucasian (i.e., 90 percent) with a population density of 1581.3 people per square kilometer (sqkm) which more closely mimics a suburban region than an urban city. As a comparison, the population density in New York City is 10,890 sqkm (US Census 2010).

Political Context

Burlington is known for its progressive politics with the iconic Bernie Sanders as its champion. Sanders was mayor from 1981 to 1989 and has been credited

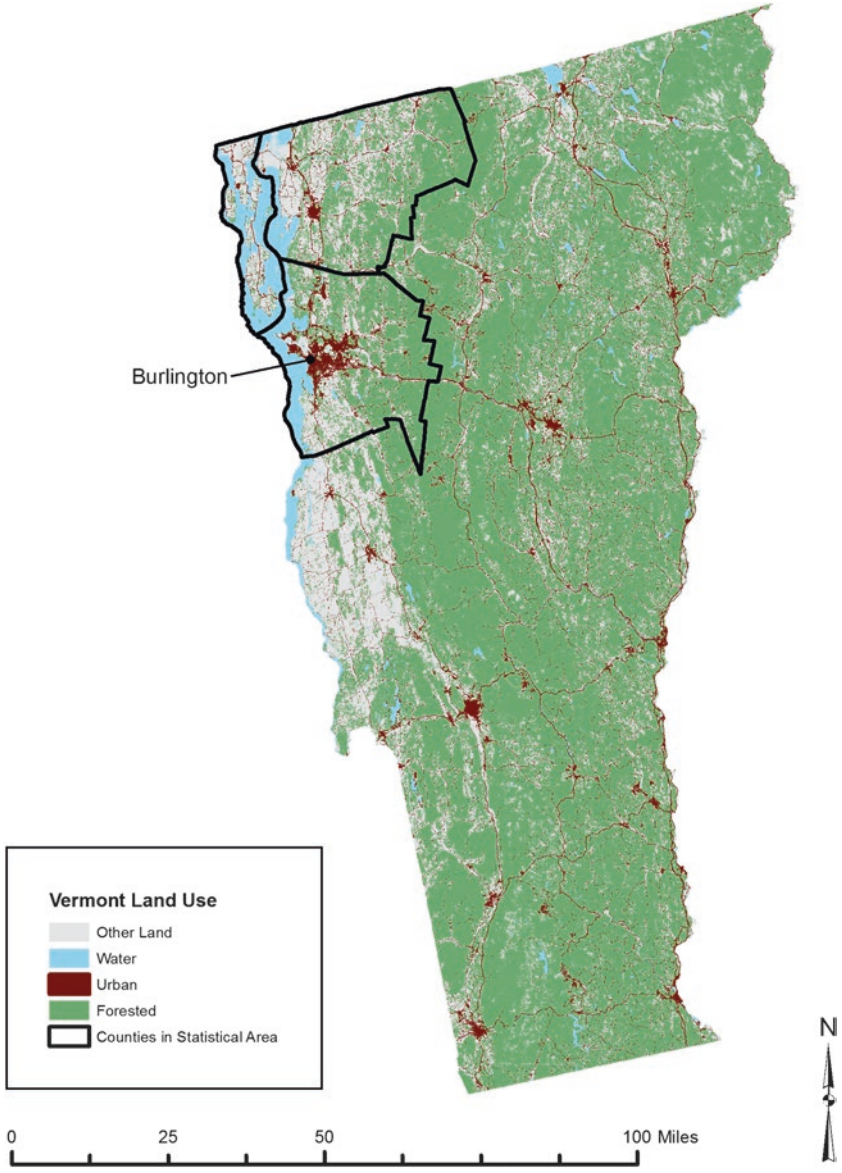


Fig. 6.1 Geographical context of Burlington, Vermont (Source: Land use data were reclassified from NLCD 2011, statistical area was obtained from US Census 2010.)

for turning Burlington into its thriving "hippie counterculture enclave" (Dreier and Clavel 2015, 1). Less mentioned are Sanders' achievements in transforming Burlington's energy system. It was under Mayor Sanders' leadership that led to the closure of Vermont's only coal power plant in 1984. While mayoral leaders after Sanders have been relatively more conservative, his progressive politics set the tone for future action toward the renewable energy transition. For example, it was under the leadership of the current mayor, Miro Weinberger, that Burlington achieved the notable 100 percent renewable electricity achievement. Mayor Weinberger continues to show leadership for energy and climate action and has joined other mayors to support the Paris Agreement after President Donald Trump withdrew from the commitments. He has stated publicly that he supports other state and local governments and organizations to achieve the Paris Agreement's goals and that "together we can and will do our part to save the planet" (Burlington 2017). In addition to the 100 percent achievement, the new ramped up goal of becoming a 100 net zero city within 10 years was advanced under Mayor Weinberger. To achieve this new goal, the following projects have been initiated in the city (from Burlington 2017):

- *Creating a multi-party Memorandum of Understanding for the purposes of exploring the feasibility of a District Energy System. Such as system would reduce the City's total carbon footprint by approximately by 20 percent.*
- *Launching the Energy Champ Challenge in the spring of 2015.*
- *Installing 13 electric vehicle (EV) charging stations, totaling 24 charging ports, in various city locations since 2013.*
- *Completing the first phase of the Waterfront Bike Path rehabilitation in January 2017, and breaking ground for the second phase in June 2017.*
- *Adopting the new Plan BTV Waal/Bike Master Plan in April 2017.*
- *Exploring an E-bus pilot program in April 2017.*
- *Launching a new Electric Vehicle rebate program in May 2017.*

Vermont's Energy Production and Consumption

Before examining how Burlington, Vermont, achieved 100 percent renewable electricity, a snapshot of both Vermont and Burlington's current energy picture is warranted. With a low population and low industrial activity, Vermont has the lowest energy consumption in total and per capita (US EIA 2017). Currently, Vermont does not produce any of its electricity from nuclear or fossil fuels, and production is primarily from renewable resources.

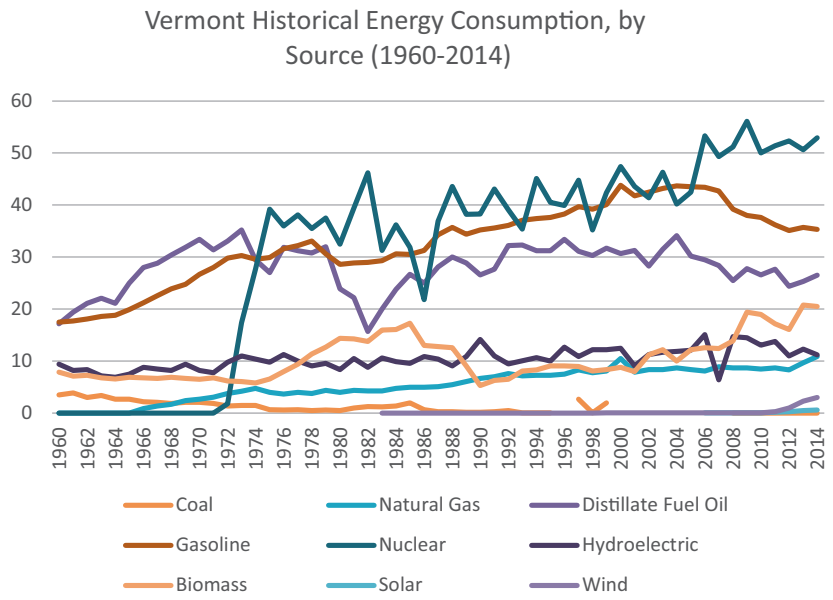


Fig. 6.2 Vermont's historical electricity consumption (1964–2014). Note that nuclear energy is the highest source in 2014. In 2015, this number went to zero. (Data obtained from US EIA 2017)

It is one of only two states that does not have an active coal plant (the other is Rhode Island). The only coal plant that was located in Vermont was in Burlington and operated from 1955 until 1984 when it was closed for good (BED 2016b). Vermont had one prior nuclear plant, Yankee Nuclear, that operated from 1972 until 2014 when it also was closed for good. At its peak, nuclear power supplied roughly one-third of the state's electrical consumption in 2014 (Fig. 6.2) (US EIA 2017). However, Vermont is rich in natural resources. Three-fourths of the state is forested (US EIA 2017), and the mountains and ample water supply make the state ideal for harnessing energy from running water and wind. Hydroelectricity represents approximately 51 percent of the state's electrical needs with most imported from Canada. There are also numerous smaller hydroelectric plants across the state. In 2016, wood and wood waste comprise approximately one-fourth of the state's electrical needs; four utility-scale wind farms make up 15 percent of the net electricity in the state; and, solar energy produced approximately four percent (US EIA 2017).

In contrast, Vermont's largest source of energy consumption is sourced from fossil fuels with 82 trillion British thermal units (TBTU) consumed

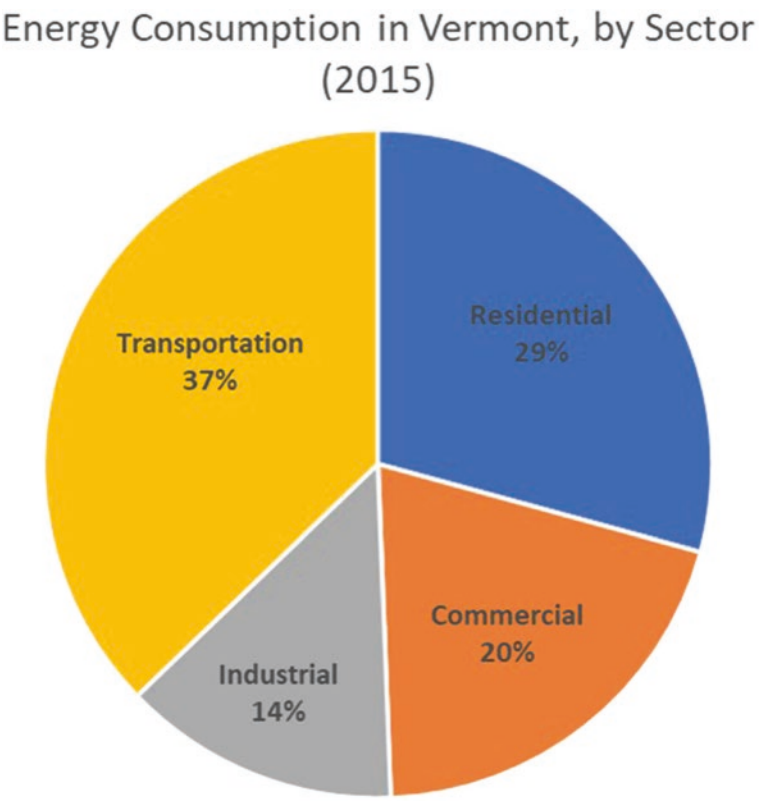


Fig. 6.3 End-use energy consumption in Vermont (Graphed using data obtained from US EIA 2017)

from petroleum and 12.2 TBTU from natural gas in 2015 (US EIA 2017). Renewables accounted for 32.2 TBTU which is roughly one-fifth of total energy consumption (Fig. 6.2). In Vermont, transportation consumes most energy (37 percent) with petroleum products comprising the majority energy source (Fig. 6.3). Residential energy consumption represents another 30 percent. In 2015, residential space heating was provided primarily from fuel oil (51 percent), followed by wood (18 percent), and wood pellets (12 percent) (Frederick and Jaramillo 2016). The use of propane and natural gas for space heating has been on the increase and using electricity for heating has decreased (Frederick and Jaramillo 2016). Natural gas is only provided in the northwestern part of the state through a pipeline from Canada. Very little electricity is used to heat buildings in Vermont. Thus, the transportation system and the heating of buildings remain dependent on fossil fuels.

Burlington, Vermont's Energy Supply

Since 2014, Burlington's energy mix has been comprised of renewable energy through a mix of owned and contracted energy sources presented in Table 6.1 and Fig. 6.4. The largest source of renewable electricity (41 percent in 2015) in Burlington is generated at the McNeil Generating Station which burns woody biomass (BED n.d.). Wood is transported to the facility mostly rail from harvested wood sourced within 60 miles of Burlington. One-third of the total energy source is provided from a number of owned and contracted hydroelectric plants, and approximately one-fifth is from two wind projects (Fig. 6.4). Solar energy is less than one percent, but investments in additional solar have been increasing in Burlington. A small amount (1.5 percent) of renewable energy was obtained through the Vermont Standard Offer which is a statewide mandatory program that requires utilities to purchase energy from small projects (e.g., hydroelectricity, biomass, farm methane, landfill methane, and solar).

Due to shortfalls caused by new renewable energy projects not completed on time, approximately nine percent of electricity was purchased through short-term contracts from ISO New England (ISO). ISO is an organization authorized in 1997 to provide reliable electricity specifically to six states (Connecticut, Rhode Island, Massachusetts, Vermont, New Hampshire, and the majority of Maine) (ISO n.d.). ISO maintains the electric grid in these states and supplies electricity to its member states through contracts. The residual fuel mix varies regularly. For example, at the time of this writing, natural gas comprises the majority of the fuel mix at 51 percent followed by nuclear, renewables, hydroelectricity, and coal (31, 10, 8, and <1 percent, respectively) (ISO n.d.).

How Burlington Achieved 100 Percent Renewable Electricity

The accomplishment of Burlington can be explained through a series of interdependent actions over the last several decades. As outlined in Table 6.2, electricity from biomass began in 1984 along with a number of long-term hydroelectric contracts providing additional supply. The remaining renewable sources were subsequently added to the portfolio with Georgia Mountain Wind in 2012 and Winooski One Hydroelectric Facility in 2014. Table 6.2 provides a chronological listing of key events that led to 100 percent renewable electricity. What follows is a list of key factors that made it possible:

Table 6.1 Burlington Electric Department (BED) electrical energy sources (2015)

Source	Resource (location)	Capacity (megawatts)	Energy (megawatt-hours)	Notes
Wood	McNeil (Burlington, Vermont)	25.0	145,180	BED is 50 percent owner and operator of this biomass plant.
Hydro	Winooski One (Vermont)	7.4	26,785	Winooski is a "run of the river" hydroelectric plant owned and operated by BED.
	NextEra Energy Power Marketing (Maine)	Varies	43,800	Contracted small-scale hydroelectric portfolio from three facilities in Maine through 2017.
	New York Power Authority (NYPA) (New York)	2.6	17,263	Hydroelectricity is contracted from two separate sources (Niagara and St. Lawrence) that expire in 2025 and 2017, respectively.
	Hydro-Quebec (Quebec, Canada)	5/9	4880	Hydroelectricity contract is for 5 MW beginning in 2015 and increasing to 9 MW in 2020. Contract is through 2035.
	VEPP Inc (Vermont)	2.2	7456	Hydroelectric contract that receives energy from Ryegate energy (beginning in 2012) and Bolton Falls and Newport Hydro (beginning in 2015).
Wind	Vermont Wind/Sheffield (Vermont)	16.0	35,006	BED receives 40 percent of the output (40 MW) through 2021.
	Georgia Mountain Community Wind (Vermont)	10.0	33,145	BED has 100 percent entitlement through 2037.
Solar	Burlington Solar (Vermont)	0.9	1117	BED is leasing the space for this fixed array is located at the airport through 2035.
Other	BED Gas Turbine (Oil) (Burlington)	22.0	217	This is a peaking unit owned and operated by BED.
	Vermont Standard Offer (Vermont)	4.4	5543	Through a statewide program, small-scale renewable energy from across the state.
	ISO New England Exchange—Net (New England grid)	n/a	33,337	Short-term purchases to make up for shortfalls. The energy source varies based on the New England residual mix which could contain electricity from natural gas, coal, or nuclear sources.
Total Energy Usage in 2015			**353,730**	

Source: BED website and IRP. https://www.burlingtonelectric.com/our-energy-portfolio

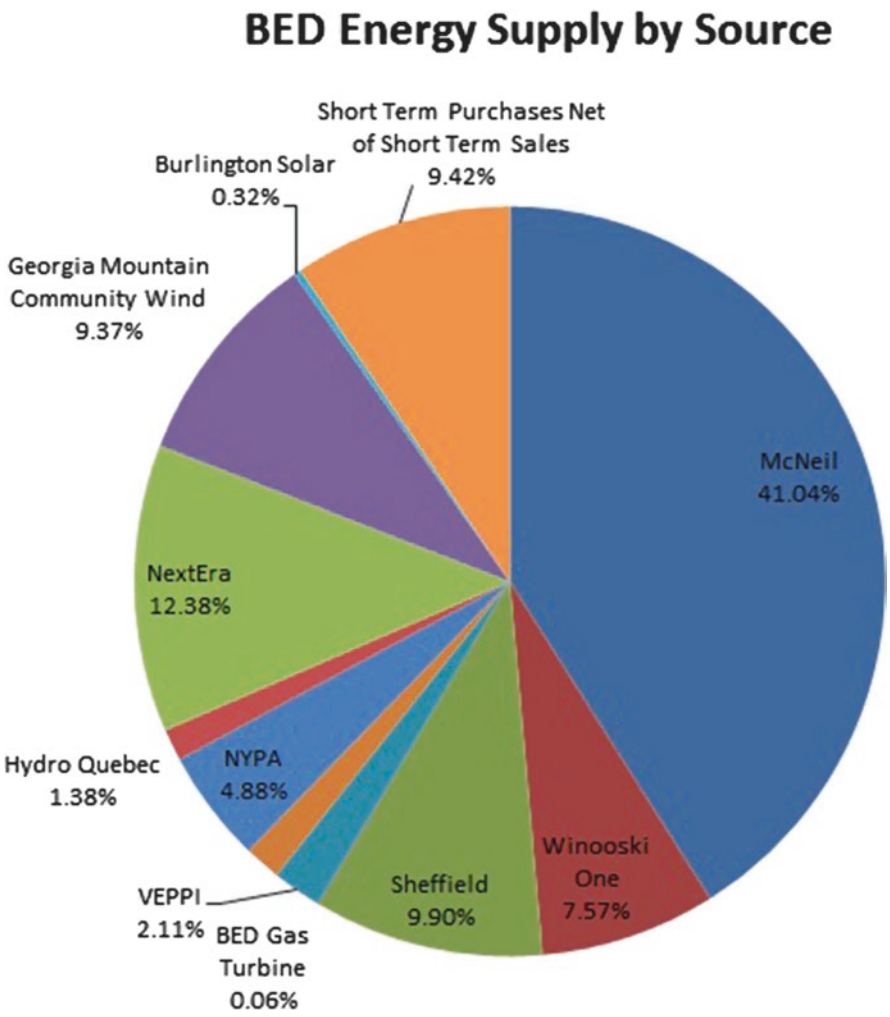


Fig. 6.4 Burlington Electric Department (BED) energy portfolio (Source: https://www.burlingtonelectric.com/our-energy-portfolio)

BED Is a Municipally Owned Utility

The first significant action was the creation of the municipally owned utility, Burlington Electric Department (BED) in 1905. This is significant because municipally operated utilities allow for the decoupling of service from profits which results in reduced rates for its customers. Municipally owned utilities have more flexibility and can be more innovative. In 2015, BED residential rates were lower than in 1990 (when adjusted for inflation) and are 9.4 per-

Table 6.2 Key events that led to 100 percent renewable energy in Burlington, Vermont

Year	Event	Description
1865	Burlington incorporates as a city	Burlington was settled in 1783 and became a town in 1785.
1905	Burlington Electric Department (BED) was established	BED is a municipally owned power which is significant in that electric rates can decouple revenues from sales.
1955	Moran Municipal Generating Station opened	30 MW coal-powered plant was opened to meet the needs of the community.
1970s	Energy Crisis (OPEC Oil Embargo)	The crisis began serious discussion on shifting toward renewable energy in the nation.
1977	Moran Municipal Generating Station retrofits completed	Beginning of renewable energy transition by converting one firing unit to burn wood. This transition was found to be less expensive than burning coal.
1984	McNeil Generating Station opened and the Moran Municipal Generating Station closed	The 30-MW McNeil Generating Station was opened to burn woody biomass and at the time could serve the needs of the community.
1998	Statewide Comprehensive Energy Plan (updated 2011 and 2016)	Among other things, the plan requires that utilities use least cost planning that not only includes financial costs but also environmental costs from energy production.
2000	Burlington Legacy Plan (updated 2013) and Climate Action Plan	The City of Burlington formalized a sustainability plan that was driven by stakeholder engagement.
2000	"Efficiency Vermont" Program Initiation	This statewide program mandates energy efficiency improvements in energy efficiency in all utilities in Vermont.
2005	Vermont joins Regional Greenhouse Gas Initiative (RGGI)	While this is a regional program, RGGI mandates reductions of greenhouse gases from electricity production and provides a market for low-carbon energy sources.
2008	McNeil Generating Plant Pollution Controls	These improvements allowed Class I RECs to be sold (i.e., REC arbitrage) and allowed no new rate hikes for the transition. Allowed quick payback on investment.
2012	Georgia Mountain Wind Farm	Provides 10 MW of energy solely to Burlington (added more to the portfolio).
2014	Vermont Yankee Nuclear Power Plant Closure	Created a need to replace nuclear energy.
2014	Purchase of Winooski Hydro plant	Significant because it brought the totals up to 100 percent renewable energy.
2015	Solar panel array installed at airport	While the capacity is relatively small, the project shows a commitment from the city in transitioning to renewable energy.

(*continued*)

Table 6.2 (continued)

Year	Event	Description
2015	Vermont Renewable Energy Standard (RES)	The RES calls for 55 percent from renewables and electrification of other fossil fuel sources beginning in 2017.
2016	"Net Zero Energy City" ten-year goal	Through the 20-year BED Integrated Resource Plan, this goal requires all of Burlington's energy needs to be met from renewable energy.

cent lower than the statewide average (BED 2016a, b). BED also has been operating its own energy efficiency programs since 1990 which BED boasts that their 20,000 customers use less electricity today per capita than they did in 1989 (BED 2016a, b).

Energy Efficiency in Burlington and Vermont Has Been a Goal Since the 1990s

Burlington has been implementing energy efficiency since its inception with a focus since 1990 (BED 2016a, b). In 1998, the state of Vermont was the first state to develop a statewide ratepayer energy efficiency utility, which is implemented through two utilities. BED is the utility that serves the Burlington area, and Efficiency Vermont serves the remainder of the state (Barbose et al. 2009). The statewide program codified energy efficiency and required utilities to adopt cost-effective programs and strengthen integrated resources plans (IRP) by requiring demand-side management (DSM) planning. In 2015, Efficiency Vermont saved 105,000 MW and $112 billion in total resource benefits (Vermont Public Service Board 2015). Success for energy-efficient utilities is evidenced by the fact that 35 states now have them (Barbose et al. 2009).

Vermont Has a Comprehensive Energy Plan Focused on Renewable Energy

Vermont developed a statewide Comprehensive Energy Plan (CEP) in 1998, which was subsequently updated in 2011 and again in 2016. The most recent CEP expanded on earlier plans and has set the following three overarching statewide goals:

- *Reduce total energy consumption* per capita *by 15 percent by 2025, and by more than one third by 2050.*
- *Meet 25 percent of the remaining energy need from renewable energy from renewable energy sources by 2025, 40 percent by 2035, and 90 percent by 2050.*
- *Three end-use sector goals for 2025: 10 percent renewable transportation, 30 percent renewable buildings, and 67 percent renewable electric power.*

The CEP is significant to utilities across the state since utilities must collectively implement programs to meet these targets. The CEP also requires that least cost planning include not only financial considerations but also the environmental costs of energy usage. In short, decision makers in Vermont utilities cannot legally ignore negative externalities which when considered make renewable energy more favorable to develop. Thus, utilities in the state are mandated to develop renewable resources as well as mitigate against environmental damage from any fuel use.

The State of Vermont Is a Member of the Regional Greenhouse Gas Initiative (RGGI)

The state of Vermont joined RGGI in 2005. RGGI is a regional pact between nine northeast states that have set a cap on carbon emissions from the electric sector. Each state implements the program through reducing GHG emissions and allocating the funds from reductions. Under RGGI, Vermont invests its allowances primarily on energy efficiency with the proceeds funding Efficiency Vermont and BED efficiency programs. Specifically, these funds support Energy Star® and other efficiency programs in businesses and low-income communities. Through participating in RGGI and from statewide energy regulation, Vermont ranked in fourth place according to the American Council for an Energy-Efficient Economy (ACEEE) (ACEEE n.d.).

BED Is Innovative Through the Use of the Renewable Energy Credit (REC) Market

Likely the most controversial of the reasons for Burlington's success is through innovative financial investments through the renewable energy credit (REC) market. An REC represents a megawatt of power generated through renewable energy and includes the "property rights to the environmental, social,

and other non-power attributes of renewable electricity generation" (EPA 2017). The REC market is managed through the New England Power Pool Generation Information System (NEPOOL GIS) which regulates the states in the ISO network (NEPOOL GIS n.d.). Each state sets up rules for the management of RECs, and Vermont has rules that allows for unbundling RECs from the electric output which allows RECs to be sold anywhere, and once the REC have been sold, they are considered retired and cannot be sold again (REV 2016).

To explain how RECs helped Burlington reach its 100 percent goal, we need to go back to 1977 when in response to the oil crisis a woody biomass boiler was retrofitted at the Moran Municipal Generating Station. It was found that the operating costs from burning wood were less expensive than burning coal. In 1984, the coal plant was closed and the wood burning McNeil Generating Station was opened to take its place, thereby ending the state's commitment to coal. In 2008, strict pollution controls were installed at the plant which allowed the Class I RECs to be sold from this plant. Here is where the innovation arises. BED then began selling Class I RECs and with the proceeds bought Class II RECs in return. Since Class I RECs are worth more than Class II RECs, this allowed excess funds to be used to repay the upgrades in the plant. After the return on investment was achieved, the excess funds were used to develop additional renewable energy capacity and are one of the reasons that have electric rates remained low. In fact, the rates in BED service area have not been raised since 2009 when this financial investment was implemented.

Burlington Has Engaged Stakeholders

The engaged population of Burlington is another reason for the success. Many of the key events were passed by voters (i.e., purchasing the biomass and hydroelectric plants and investing in pollution controls at McNeil). The city also engaged its stakeholders in the development of its first sustainability plan in 2000, called the Legacy Plan as well as a comprehensive Climate Action Plan in the same year (Burlington 2000a, b).

Burlington and Vermont Geography Are Conducive for Renewable Energy

Another reason can be attributed to geography. Vermont is three-fourths forested and has vast resources of available wood products. The region is also

blessed with mountains and water resources that allow for the development of hydroelectricity in the region and through long-term contracts with neighboring Canada and other New England states.

Lessons Learned

Many have questioned whether the success in Burlington, Vermont, could be scaled to larger municipalities given that Vermont has a small population that is rich in wood, wind, and water. From personnel communications, with Mayor Weinberger and the BED employees, the following list provides some key lessons learned and strategies that can be applied at other locations:

- Political will may be the most important factor in attempting to solve a difficult societal problem like addressing climate change. Burlington's political figures, municipal workers, and residents have been leading the way for decades. The Burlington case shows that dedicated and persistent leadership can actually affect change.
- Having a publicly owned utility is instrumental in achieving the target since BED is not beholden to shareholders but rather to its ratepayers. While shifting the ownership of electric companies across the nation may not be feasible, enacting policies that decouple service from profits may result in a faster transition toward renewable energy.
- Energy efficiency needs to be the first line of attack. If it were not for energy efficiency programs, Burlington would not have been able to achieve the 100 percent renewable power target. Thus, the model of a statewide energy efficiency utility and a focus on energy efficiency programs will lessen the need for additional power generation.
- Burlington was able to use innovative policy instruments, namely, RECs, to fund additional renewable energy projects while keeping rates low.

Challenges and Barriers

While the achievements of Burlington should be celebrated, there are some challenges and barriers to consider as Burlington moves to the next challenge of becoming a net zero city. The first is that the majority of energy consumption in the city and state are from transportation and residential heating which relies heavily on fossil fuels. Burlington is addressing this challenge through targeted initiatives such as installing electric vehicle (EV) recharging stations

and a rebate program for EVs. For heating, the trend has been to replace fuel oil with wood; however, natural gas and propane have also been on the increase (as discussed above). Fuel oil, natural gas, and propane have long been used for heating, and changing the systems out with renewable resources may take time to transition. For example, the only natural gas utility in the state, Vermont Gas, acknowledges the renewable energy goals of the state and the net zero goal of Burlington in its 2016 IRP but states that changes in expansion have not been considered at this time and is expanding service into five additional communities (Vermont Gas 2017).

Another challenge not specific to Burlington but absolutely applicable is the lack of infrastructure to support distributed renewable energy systems. This challenge includes finding funds to build new transmission lines to connect to the grid. In addition, the development of new permitting systems and standards is in a nascent stage, and workers must be trained to operationalize new renewable energy systems. These challenges are slowly being overcome, and Vermont has been leading the way. For example, Vermont was the first state to establish a feed-in tariff which incentivizes small-scale distributed energy systems by lowering the price of electricity (Sovacool et al. 2014). Green Mountain Power, the state's only investor-owned electric utility, was the first utility to team with Tesla to install 500 Powerwall systems to store the energy generated from solar panels (NBC News 2016).

Lastly and likely the most important challenge to a full transition to renewable energy is the uncertain and ever-changing nature of federal and state energy policy. Some analysts feel that federal preemption of state clean energy policies is on the horizon (Stronberg 2017); however, it is unclear if such an initiative would stand up in court. Federal policies that promote fossil fuels are more likely to thwart progress on developing renewables. The Trump administration's energy policy is devoid of a clear expansion of renewables and is strongly supportive of continued fossil fuel usage. Namely, Trump's policy is to reverse the Clean Power Plan, to clear roadblocks for the Keystone XL Pipeline, and to reduce regulations that harm the coal industry (White House 2017). Based on analysis from the Obama administration, the estimated subsidies allocated to US oil companies add up to over four billion dollars a year (McDonnell 2017). Variability within state energy policies can be uncertain as states and utilities look to add more renewable energy to their portfolio. For example, all states in New England have some form of an RPS; however, the markets are not uniform across each state. For example, RECs from biomass qualify in Maine, but not in Massachusetts, and Vermont allows for large-scale hydroelectricity where other states do not (Gerwatowski 2016). Another clear point is that the markets are complex and not explicitly transparent with

concerns over double counting leading the critiques of the REC market. However, state renewable energy policy shows no sign of slowing, and the REC market has been pointed to as a primary driver in advancing renewable energies (Gerwatowski 2016).

Further Reading

Burlington Electric Department General Information. https://www.burlingtonelectric.com/.

Burlington Electric Department's Integrated Resource Plan (2016). https://www.burlingtonelectric.com/irp.

Burlington Legacy Plan.https://www.burlingtonvt.gov/Sustainability/Legacy-Action-Plan.

Burlington's Climate Action Plan and District Energy Study. https://www.burlingtonvt.gov/Sustainability/CAP.

Efficiency Vermont Information. https://www.efficiencyvermont.com/.

PBS Special on Burlington, Vermont. http://www.pbs.org/newshour/bb/vermont-city-come-rely-100-percent-renewable-energy/.

References

Abotah and Daim. 2017. Toward Building a Multi Perspective Policy Development Framework for Transition Into Renewable Energy. *Sustainable Energy Technologies and Assessments* 21: 67–88.

American Council for an Energy-Efficient Economy (ACEEE). State and Local Policy Database. Available at: http://database.aceee.org/.

Barbose, Galen, Charles Goldman, and Jeff Schlegel. 2009. *The Shift Landscape of Ratepayer-Funded Energy Efficiency in the US*. Berkeley: Ernest Orlando Lawrence Berkeley National Laboratory. Available at: https://energy.gov/sites/prod/files/oeprod/DocumentsandMedia/LBNL_Shifting_Landscape_of_Ratepayer_Energy_Efficiency_REPORT.pdf.

Burlington, The Legacy Plan. 2000. Available at: https://www.burlingtonvt.gov/Sustainability/Legacy-Action-Plan.

Burlington, Vermont Climate Action Plan. 2000. Available at: https://www.burlingtonvt.gov/Sustainability/CAP.

Burlington. 2017. *Mayor Weinberger Joins Open Letter to International Community and Parties to the Paris Agreement Stating "We Are Still In;" Affirms City of Burlington's Commitment to Paris Agreement Goals*. Available at: https://www.burlingtonvt.gov/Press/Mayor-Weinberger-Joins-Open-Letter-to-International-Community-and-Parties-to-the-Paris.

Burlington Electric Department (BED). n.d. *McNeil Generating Station Information*. Available at: https://www.burlingtonelectric.com/more-mcneil.

_____. 2016a. *Integrated Resources Plan (IRP)*. Available at: https://www.burlingtonelectric.com/irp.

———. 2016b. *Performance Report*. Available at: https://www.burlingtonelectric.com/sites/default/files/inline-files/2016_pmr_vfr.pdf.

California Energy Commission. Renewable Energy Overview and Programs. (2017). Available at: http://www.energy.ca.gov/renewables/. Accessed 25 Sept 2017.

Cheng, Quan, and Hontao Yi. 2017. Complementarity and Substitutability: A Review of Renewable Energy Policy Instrument Interactions. *Renewable and Sustainable Energy Reviews* 67: 683–691.

Dixon, Robert K., Elizabeth McGowan, Ganna Onysko, and Richard M. Scheer. 2010. US Energy Conservation and Efficiency Policies: Challenges and Opportunities. *Energy Policy* 38 (11): 6398–6408.

Dreier and Clavel. 2016. Bernie's Burlington: What Kind of Mayor Was Bernie Sander's? *Huffington Post*, 4 June. Available at: http://www.huffingtonpost.com/peter-dreier/bernies-burlington-what-k_b_7510704.html.

El-Ashry, Mohamed T. 2012. National Policies to Promote Renewable Energy. *American Academy of Arts and Sciences* 141 (2): 105–111.

Frederick, Paul and Jaramillo Diana. 2016. *Vermont Residual Fuel Assessment*. Available at: http://fpr.vermont.gov/sites/fpr/files/About_the_Department/Library/Library/FINAL_2015%20Residential%20Fuel%20Assessment%20Report.pdf.

Gerwatowski, Ron. 2016. *2016 Report of the Consumer Liaison Group*. Available at: https://www.iso-ne.com/staticassets/documents/2017/03/2016_report_of_the_consumer_liaison_group_final.pdf.

Green, David L., and Changzheng Liu. 2015. US Oil Dependence 2014: Is Energy Independence in Sight? *Energy Policy* 85: 126–137.

ISO – New England. n.d. Available at: https://www.iso-ne.com/.

Jacobs, Meg. 2016. *Panic at the Pump: The Energy Crisis and the Transformation of American Politics in the 1970s*. New York: Hill & Wang.

McDonnell. 2017. *Forget the Paris Agreement. The Real Solution to Climate Change Is in the U.S. Tax Code*. Available at: https://www.washingtonpost.com/news/wonk/wp/2017/10/02/forget-the-paris-agreement-the-real-solution-to-climate-change-is-in-the-u-s-taxcode/?utm_term=.8c16de0261b0.

National Land Cover Database (NLCD). 2011. Available at: https://www.mrlc.gov/nlcd2011.php.

National Conference on State Legislatures (NCSL). 2017. *State Renewable Portfolio Standards and Goals*. Available at: http://www.ncsl.org/research/energy/renewable-portfolio-standards.aspx.

NBC News. 2016. First Battery-Powered Home Goes Online in Vermont. Available at: http://www.mynbc5.com/article/first-battery-powered-homegoes-online-in-vermont/3327077.

New England Power Pool Generation Information System (NEPOOL). n.d. Available at: http://www.nepoolgis.com/.

New York State. n.d. *Clean Energy Standard*. Available at: https://www.nyserda.ny.gov/All-Programs/Programs/Clean-Energy-Standard.

Outdoor Industry Association (OIA). 2017. *Vermont Outdoor Recreation Economy Report*. 26 July. https://outdoorindustry.org/resource/vermontoutdoor-recreation-economy-report/.

Peters, Adele. 2015. It's Actually Kinda Easy Being Green. *Fast Company* 198. Available at: https://www.fastcompany.com/50154/its-easybeing-Green.

Renewable Energy Vermont (REV). 2016. *Renewable Energy Credits*. Available at: http://www.revermont.org/wp-content/uploads/REC-Factsheet-REV-4-14-2016.pdf.

Science News. 2008. Rock Port, Missouri, First 100 Percent Wind-powered Community in U.S. Available at: https://www.sciencedaily.com/releases/2008/07/080715165441.htm.

Sierra Club. 2017. *Transitioning All Electricity in US Cities to 100% Renewable Energy Will Reduce Carbon Pollution and Help US Meet Paris Climate Agreement Targets*. Available at: https://www.sierraclub.org/sites/www.sierraclub.org/files/blog/RF100Report622.pdf.

Sovacool, Benjamin, Alex Gilbert, and Brian Thomson. 2014. Reviewing, Reforming, and Rethinking Global Energy Subsidies: Towards a Political Economy Research Agenda. *Ecological Economics* 135: 150–163.

Stronberg. 2017. *Clean Energy in the Age of Trump Means Federal Preemption of State Incentives*. Available at: http://www.renewableenergyworld.com/ugc/articles/2017/07/21/clean-energy-inthe- age-of-trump-means-federal-preemption-of-state-incentives.html.

US Census. 2010. *Decennial Census Population Statistics*.

———. 2016. *American Community Survey Population Statistics*.

US EIA. 2017. *Total Energy Overview*. https://www.eia.gov/totalenergy/. Accessed 25 Sept 2017.

US Energy Information Administration (US EIA). 2012. *US Petroleum Product Exports Exceed Imports for the First Time in Over Six Decades*. https://www.eia.gov/todayinenergy/detail.php?id=5290.

US Environmental Protection Agency (US EPA). 2017. *Inventory of US Greenhouse Gas Emissions and Sinks: 1990–2015*. https://www.epa.gov/ghgemissions/inventory-us-greenhouse-gas-emissions-and-sinks-1990-2015. Accessed 25 Sept 2017.

Vassar, Michael. 2016. Incentives or Mandates? determinants of the Renewable Energy Policies of US States, 1970–2012. *Social Problems* 63 (2): 284–301.

Vermont Gas. Integrated Resource Plan (IRP). 2017. Available at: http://www.vermontgas.com/wp-content/uploads/2017/09/2017-IRP.pdf.

Vermont Public Service Board. 2015. *Report on 2015 Energy Efficiency Utility Program Revenues and Expenditures Pursuant to 30 V.S.A. § 209(d)(3)(A)*. Available at:

http://puc.vermont.gov/sites/psbnew/files/doc_library/EEUReportToLegislature2015%28Jan2017%29.pdf.

———. 2016. *Vermont Comprehensive Energy Plan*. Available at: http://publicservice.vermont.gov/publicationsresources/publications/energy_plan/2015_plan.

White House. 2017. *President Trump's Energy Independence Policy*. Available at: https://www.whitehouse.gov/the-pressoffice/2017/03/28/president-trumps-energy-independence-policy.

7

Greenhouse Gas Management: A Case Study of a Typical American City

Rachel M. Krause and J. C. Martel

Background

Climate Change and the Importance of GHG Mitigation

Climate change is arguably the single over-riding sustainability issue of our time. It has the potential—already to some extent being realized—to disrupt the relatively stable climate of the past millennia, dramatically alter the Earth's land cover, and negatively impact social and economic well-being. These threats and their well-established connection to human activity, most notably the burning of fossil fuels, have resulted in great global concern about the amount of greenhouse gas (GHG) emissions being released into the atmosphere. However, complex collective action dynamics—whereby self-interest prevents rational actors from working together to produce a shared good (Olson 1965; Ostrom 1990)—have hindered the international cooperation and action needed to obtain meaningful GHG reductions (Wolinsky-Nahmias 2015).

In early 2015, the average global concentration of carbon dioxide (CO_2) in the atmosphere reached 400 parts per million (ppm) for the first time in over a million years. Although it is a symbolic number, it provides a powerful illustration of the rate at which the concentration of atmospheric carbon has been

R. M. Krause (✉) • J. C. Martel
School of Public Affairs and Administration, University of Kansas, Lawrence, KS, USA

R. Brinkmann, S. J. Garren (eds.), *The Palgrave Handbook of Sustainability*,
https://doi.org/10.1007/978-3-319-71389-2_7

increasing: notably, it is 120 ppm higher than in pre-industrial times and a full 60 ppm higher than it was in just 1980 (Allen 2015).

Since the start of the industrial revolution, the average global temperature has also increased by almost 0.9 degrees Celsius (°C) or 1.6 degrees Fahrenheit (°F). To uninformed observers this may seem like a small increase; however, it is a significant step toward the 2 °C (3.6 °F) warming that is the internationally accepted limit expected to be able to forestall "runaway climate change" (UNFCCC 2009). The current scientific consensus indicates that stabilizing atmospheric carbon at 450 ppm will provide a 50 percent chance that the global average temperature increase will remain below the 2 °C threshold. To achieve this stabilization, however, GHG emissions need to be reduced dramatically and quickly. The Intergovernmental Panel on Climate Change (IPCC) calls for a 40–70 percent decrease in global emissions below 2000 levels by 2050 and zero or even net negative emissions by the end of the century (IPCC 2014).

Even if dramatic emission reductions do occur, some amount of climate change is inevitable and, indeed, is already occurring (IPCC 2014). Given this, public policies related to climate change often emphasize both GHG mitigation and adaptation. Whereas the former aims to minimize emissions and the corresponding increase in global temperature, the latter aims to help communities anticipate and be resilient to the changes and extreme weather events that accompany climate change. Although mitigation and adaptation go hand in hand as part of a comprehensive response to climate change, they face different sets of obstacles, and the strategies needed to achieve them are vastly different (Bulkeley et al. 2009; Sippel and Jenssen 2009). The parameters around mitigation activities are relatively clear: they involve reducing GHG emissions primarily by decreasing fossil fuel burning (whether via conservation, efficiency, or a shift to cleaner energy sources) and, to a lesser extent, changes in waste management and agricultural practices. The range of activities involved with climate adaptation, on the other hand, is considerably broader. Climate-induced threats include increased risk of floods, drought, wildfires, hurricanes, and extreme heat, and, for each, adaptation requires the cooperation of diverse actors with objectives that range from immediate disaster relief to long-term prevention planning (Bulkeley et al. 2009). However, unlike with mitigation, adaptation initiatives generate benefits that are direct and local, and they are thus generally not subject to collective action-induced challenges. This chapter focuses on the mitigation side of climate change policies and specifically the measuring, monitoring, and managing of greenhouse gas emissions.

Measuring and Managing Greenhouse Gas Emissions

Carbon dioxide (CO_2) is the main GHG emitted as a result of human activity—for example, over 80 percent of US GHG emissions are in the form of CO_2 (US EPA 2014)—but it is by no means the only one. The IPCC lists over 60 distinct chemical compounds that have global warming effects, although CO_2, along with methane (CH_4) and nitrous oxide (N_2O), account for the vast majority of emissions. Despite its prevalence, carbon dioxide is a relatively "weak" GHG. That is, when compared to other GHGs, its Global Warming Potential (GWP) is relatively low. The GWP of methane, for example, is 25 times stronger than that of carbon dioxide, meaning that over a 100-year period of time, one molecule of methane will cause 25 times more warming than one molecule of carbon dioxide. Nitrous oxide is 298 times stronger than carbon dioxide. To account for these differences, GHGs are often expressed in terms of "carbon dioxide equivalents" or CO_2e. This weighted unit is calculated by assigning carbon dioxide a Global Warming Potential value of 1, with the GWPs of all other GHGs being determined *relative* to it. This standardization is an important step in the measurement and management of GHG emissions.

Climate Protection Efforts at Different Levels of Government

International Climate Agreements

Climate change is a global issue and is traditionally seen as being best addressed at an international level. However, it poses a quintessential collective action challenge since no matter where in the world they are released, emissions have the same atmospheric impact. One country's actions to reduce its emissions will produce little improvement unless other countries do the same. Although it has been on the international agenda for almost 30 years, meaningful international cooperation on climate change has been elusive. The 1992 United Nations Framework Convention on Climate Change (UNFCCC) represents the first international action on the issue and established voluntary reduction goals for GHG emissions. This was superseded by the 1997 Kyoto Protocol, which entered into force in 2005 after being ratified by enough countries to account for 55 percent of the world's 1990 emissions. It required binding reductions for participating industrialized countries, averaging five percent below their 1990 emissions by 2012. It set no limits on the emissions of

developing countries, including India and China, and had no effect on countries that did not ratify it, like the United States, or that dropped out, like Canada. The impact that the Kyoto Protocol has had on global emissions is debated, but even optimistic evaluations suggest that it achieved only modest reductions that are far below what is necessary to slow the march toward a dangerously warmer global climate (Grubb et al. 2002).

Most recently, delegates from around the world met in Paris for the 2015 UN Climate Change Conference (COP21), and 196 countries signed an agreement limiting the emissions of all countries to levels expected to keep the average global temperature increase to within the "safe" 2 °C range. Financial exchanges from wealthy countries to poor ones are an important component of the Paris Agreement and will assist the poorer countries both mitigate emissions and adapt to the changes in climate that will occur. Although regarded as a "surprising success" in its ability to bridge international differences and secure commitments, it is far too early to determine its ultimate impact (Sweet 2015; Rogelj et al. 2016). The United States' abdication from its Paris commitments in early 2017 cast a large shadow on the initial optimism generated by the agreement, but, thus far, no other countries have followed suit and many have reconfirmed their commitments in response.

US Federal Policy

At approximately 6870 million metric tons of CO_2e a year, the United States is the second largest total emitter of GHGs, behind China (US EPA 2016). Emissions come primarily from electricity generation, followed by transportation, and industrial activity (Fig. 7.1).

The United States lacks comprehensive climate legislation at the federal level. Although hundreds of bills have been introduced, none have progressed through Congress. The most recent serious attempt occurred in 2009 during the 111th Congress when Democrats had control of the Senate, the House of Representatives, and the White House. The House of Representatives managed to narrowly pass HR 2454 (Waxman-Markey), whose major component was a cap-and-trade-based GHG management system. The Senate, however, was unable to secure a filibuster-proof number of votes to pass it. No serious attempts have been made since that time, and the prognosis for comprehensive climate legislation getting through Congress in the near future remains dim.

However, while action to address climate change has stalled on the legislative side, some albeit temporary progress has been made in the judicial and

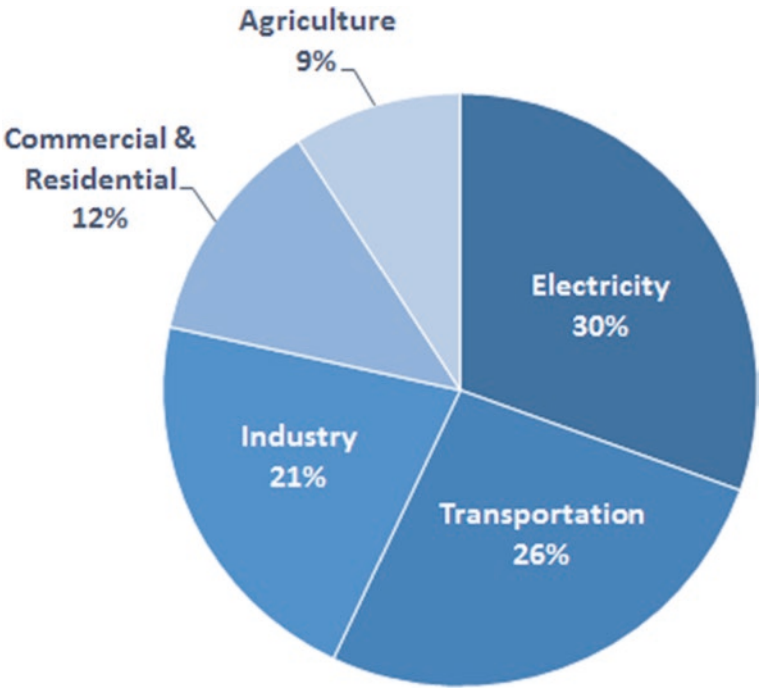


Fig. 7.1 US GHG emissions by sector, 2014 (Source: US Environmental Protection Agency 2016)

executive branches of government. In an important 2007 decision known as *Massachusetts v. Environmental Protection Agency*, the US Supreme Court ruled in favor of the petitioners (a coalition of 12 states, several cities, and non-governmental organizations) to require the Environmental Protection Agency (EPA) to regulate GHGs under the Clean Air Act. This spurred the EPA to develop new rules for GHG management, most notably new GHG vehicle emissions standards and the Clean Power Plan (CPP). The vehicle emissions standards, established in conjunction with the Department of Transportation, require cars and light trucks to meet a fleet-wide equivalent of 54.5 miles per gallon (approximately 4.3 liters/100 km) by 2025 (US EPA 2012).

The CPP, which was created as an executive action under the Obama administration but is unlikely to be implemented under the Trump administration, was the most significant recent attempt to reduce carbon emissions in the United States. It targeted electricity production from power plants and would have required carbon pollution from the power sector nationwide to reach 32 percent below 2005 levels by 2030. The CPP assigned differential

reduction requirements to states based on their existing carbon intensity and their ability to incorporate more renewables into energy production. Reduction requirements range from seven percent (Connecticut) to 48 percent (South Dakota). Each state was directed to develop its own plan for how to meet its specified reduction goal. Not unexpectedly, the CCP was greeted with opposition from many states and industry groups. In early 2016, in response to an application filed by 29 states, the Supreme Court stayed the implementation of the plan, pending judicial review. The CPP has been abandoned entirely under the Trump administration, which has consistently denied climate science.

US State and Regional Efforts

Those disappointed by the slow progress being made to manage GHG emissions by the national government may be somewhat heartened by the initiatives taking place at lower levels. Although smaller in scale and impact than corresponding nationwide policies would be, it has been observed that "… federal actions (or the lack thereof) can seems like a sideshow in climate change policy compared to the flurry of activity that has taken place at the state and regional level over the last twenty years" (Wallach 2012, 2). That said, in part due to the election of a large number of conservative governors and state legislatures, the momentum of these subnational efforts has likewise declined in recent years (Rabe 2015).

Between 2005 and 2007, three regional cap-and-trade initiatives were active: Regional Greenhouse Gas Initiative (RGGI), Western Climate Initiative (WCI), and Mid-Western Greenhouse Gas Reduction Accord (MGGRA). Together they boasted 21 US states as members and 8 more as observers. Several Mexican states and Canadian provinces also participated. As part of each agreement, participating states jointly established GHG reduction goals, which could be met through direct mitigation or by trading emissions credits. As of 2015, only one of these regional agreements, RGGI, remains active with multiple US members (Center for Climate and Energy Solutions 2016). The nine northeastern states currently in RGGI (Connecticut, Delaware, Maine, Maryland, Massachusetts, New Hampshire, New York, Rhode Island, and Vermont) have agreed to cap GHG emissions from power plants by 2.5 percent a year below 2012 levels between 2014 and 2020.

A considerable number of US states have individually engaged in explicit climate protection goal setting and planning—for example, 20 have set statewide GHG reduction targets and 34 have adopted climate action plans.

However, most of these lack teeth and thus have limited impact (Center for Climate and Energy Solutions 2016). Many of the state-level initiatives with the largest potential impacts on GHG emissions operate as "stealth policies" which avoid direct mention of climate protection and instead target related energy issues (Rabe 2004). Renewable portfolio standards (RPSs) are one of the most common state-level clean energy policies. Seven states have voluntary and 30 states have binding RPSs, each of which requires that utilities meet specified renewable energy targets by a certain date (Center for Climate and Energy Solutions 2016). Overall, RPSs have been evaluated as a modestly effective decarbonization tool (Carley and Brown 2013). Although they do generally result in an increased production of renewables, they neither require the displacement or reduction of GHG emissions from fossil fuel-based electricity, and thus RPSs have less of a carbon impact than policies explicitly designed for carbon mitigation, such as cap-and-trade or a carbon tax (Palmer and Burtraw 2005; Bird et al. 2011). Other common state energy policies, which may not explicitly target climate change but nonetheless have significant implications for GHG emissions, include various tax incentives for the purchase of renewable or efficient energy systems; Energy Efficiency Resource Standards (EERS), which require that utilities improve the efficiency of their own infrastructure; and net metering and interconnection standards which set the rules for utility customers who generate their own electricity, such as through rooftop solar, for connecting to and selling electricity back to the larger grid (Carley and Browne 2013; Center for Climate and Energy Solutions 2016). These efforts led some to contend that the "United States *does* have a climate policy, albeit one that consists of a number of rather fragmented pieces…" (Rabe 2015, 56).

Whereas numerous states have approached GHG management indirectly or through weak goals and voluntary commitments, California has taken explicit and aggressive actions on climate protection. In 2006, the state passed AB32, the California Global Warming Solutions Act, which remains the only piece of comprehensive climate legislation in the country. AB32 commits the state to reduce its GHG emissions to 1990 levels by 2020 and directed the California Air Resources Board (CARB) to establish regulations to meet this goal. As spelled out in its Scoping Plan, AB32's GHG mitigation approach rests on a suite of four strategies: an overall cap-and-trade system, a renewable portfolio standard, and two policies that focus on reducing vehicle emissions, the Low-Carbon Fuel Standards and Advanced Clean Car Standards (CARB 2014). In June 2017, the state legislature voted to extend one component of this program, its cap-and-trade requirement, for an extra decade, making it

not set to expire until 2030. California also passed SB350, which contains legally binding clean energy initiatives—including requirements that half of the state's electricity be generated from renewable sources and that energy efficiency be doubled in residential and commercial buildings. It has been touted as "the most significant act of energy and climate policy leadership in any state since AB 32" (Semple 2015).

Municipal Climate Protection Efforts

A substantial portion of the ongoing climate protection actions in the United States and around the world are being undertaken at the municipal level, particularly by and within cities. As home to 54 percent of the global population and the source of an estimated 60 percent of anthropogenic CO_2 emissions (UN Habitat 2016), cities are significant contributors to the problem of climate change. They are also some of the places where its damaging effects are expected to be most concentrated, and they represent the level of government closest to the people who will have to make changes to mitigate emissions. Their place at the nexus of cause, consequence, and authority makes cities particularly important actors in GHG management (Krause 2011). Recognizing this, numerous organizations and networks have emerged dedicated to encouraging and enabling cities to work to effectively mitigate their emissions. Internationally, some of the most notable include ICLEI—Local Governments for Sustainability, the Global Covenant of Mayors for Climate and Energy, and C40 Cities, which together represent over 7100 cities and 600 million people (Watts and Van Begin 2016).

Although US states have traditionally been referred to as "laboratories of democracy," this label, increasingly, may be better affixed to cities (Bulkeley and Castán Broto 2013; Singh 2005). Their sheer number—over 19,000 in the United States—provides fertile ground for the emergence of many policy experiments which can vary considerably in terms of scale, scope, and substance. In the United States, where 84 percent of the population is urban (US Census 2010), over 1000 cities covering approximately 30 percent of the population have made some sort of explicit climate protection commitment (US Conference of Mayors 2016). In many locales, mayors have been identified as particularly important "champions" of local climate protection efforts. Their leadership is often motivated by a desire to develop a reputation—both for their cities and themselves personally—of being innovative, progressive, and green (Hughes 2016). Moreover, cities are relatively protected from partisan politics and much of the policy gridlock that it causes, so are often more

able to pursue innovative initiatives including those associated with climate protection.

Despite variation in mitigation targets and specific policies implemented, many climate-active cities follow a similar basic process for managing their GHG emissions. A typical initial step involves the creation of a GHG emissions inventory which identifies and quantifies a city's primary sources of emissions. Reflecting the logic "if you can measure it, you can manage it," emissions inventories are often considered a critical first step for comprehensive GHG reduction efforts (ICLEI 2015). They are, however, data intensive and can require considerable capacity and technical skill to complete, limiting the degree to which cities with limited resources can pursue them. To help ease the burden of this task, non-profit organizations, perhaps most notably ICLEI—Local Governments for Sustainability, have developed specialized software and guidelines to assist cities' development of emissions inventories. Once emissions are identified in an inventory, common next steps include adopting an emissions reduction target and developing a climate action plan (CAP) which spells out a mitigation strategy for the city. Next is the critical step of implementing the CAP and transitioning planning into action. Particularly committed cities conduct emissions inventories on a regular basis to assess their progress and evaluate their strategies. ICLEI has formalized this general process as part of its "Five Milestones" for city members (ICLEI 2015).

Cities tend to divide their efforts between actions aimed at reducing emissions in their own government operations and more broadly in the community as a whole. In most locales, emissions from municipal government operations, such as those associated with powering city buildings and vehicle fleets, account for less than five percent of the community total (Krause 2012). However, despite the much larger potential of community-focused initiatives, a majority of city governments begin their climate protection journeys with an internal focus and emphasize energy efficiency. There are a variety of reasons for this initial emphasis, including the benefits of cost and energy savings for the city government, greater certainty over mitigation outcomes, and less political controversy. When cities pursue community-focused climate protection efforts, they often emphasize those that, along with reducing GHGs, yield co-benefits such as better urban air quality, decreased traffic congestion, or improved walkability.

A primary criticism of local efforts is that they often fail to implement policies that are actually capable of achieving their committed to mitigation objectives, reflecting a "stubborn gap" between the promise and reality of local efforts (Betsill and Bulkeley 2007). With some notable exceptions—like

Boulder, Colorado, where residents voted to pass a self-imposed carbon tax on electricity, and San Diego, California, which adopted a legally binding GHG reduction goal—cities generally utilize voluntary mechanisms and focus on low-hanging fruits. Policy tools like information, service provision, and positive incentives, which attempt to bring about behavior changes through non-coercive means, are most common (Krause 2011). Although typically more politically acceptable, these policy tools tend not to yield desired outcomes as effectively as those that are more authoritative (Salamon and Elliott 2002).

The next section of this chapter focuses on the GHG mitigation efforts in Kansas City, Missouri (KCMO). Unlike cities such as Boulder, San Francisco, New York City, and Seattle, KCMO is not one of the places that typically comes to mind when thinking of innovators in local climate protection. It is selected as a case study explicitly because of its relative normalcy and its corresponding ability to illustrate the efforts and challenges faced by local governments following a more "typical" climate protection trajectory. KCMO is pursuing GHG mitigation efforts in a context of limited resources, competing priorities, and occasional political pushback, which increases the relevance of its experience to many other cities.

Case Study: GHG Management in Kansas City, Missouri

City Overview

Kansas City, Missouri (KCMO), is a city of 475,000 located in a metro area of over two million people crossing the states of Kansas and Missouri. It is a politically liberal city in a conservative state, which sometimes causes tensions over policy and has resulted in threats of state preemption when the city is perceived as "overstepping its bounds." Compared to the larger surrounding area, it is racially and ethnically diverse with its two largest minority groups, African Americans and Latinos, making up 30 percent and ten percent of the city's population, respectively (US Census 2010). KCMO faces many "typical urban" problems including crime, poverty, and a struggling school district that lost its accreditation in 2012. It is simultaneously also a part of the "urban revival" taking place across the United States and boasts a world-class art museum, a newly minted streetcar, several professional sports teams, and a downtown residential population that has quadrupled in the last ten years. As described by Mayor Sly James, the city faces an overall challenge to "make

tough choices to keep our momentum going" (James 2016). It is in this context that KCMO's policies for greenhouse gas emission management are being developed and implemented.

A Local History of Climate Protection Planning

"Kansas City is dirty brown. In the last half of the 20th century, the city government is seldom on the cutting edge of novel environmental ideas, even the basic ones such as green buildings and recycling and brownfields…" or so began a newspaper article published in the Kansas City Star in 2006 (Dillon 2006). KCMO's journey from environmental laggard to becoming a serious player in the local climate protection landscape began in 2005 with the confluence of three related decisions: (1) the then City Manager Wayne Cauthen advanced a vision of Kansas City as an environmental leader and reorganized city government units to convert the existing department of environmental management into an office of environmental quality within the city manager's office and provide it with authority to address a broader range of issues; (2) a new position of chief environmental officer was created to head the unit, and Dennis Murphey, a former instructor at the University of Kansas and head of Cincinnati's office of environmental management, was hired to fill it. Ten years later, he still retains that position; and (3) Mayor Kay Barnes, who had not previously assumed environmentally progressive positions, signed on to the US Mayors Climate Protection Agreement (Dillon 2006). The Agreement established a new policy goal for the city: reducing local GHG emissions to seven percent below 1990 levels by 2012, which aligned with the goal for the United States established by the Kyoto Protocol. Initial efforts were bolstered by a recommendation made by KCMO's Environmental Management Commission, a long-standing formal body of community members appointed by the mayor, that the city develop and adopt a climate action plan to achieve its mitigation commitments.

The new climate goals initially surprised city staff and community stakeholders and caused some question about the types of follow-through actions that would be necessary to achieve them. Mayor Barnes appointed an 11-member steering committee and staff and assembled four technical work groups composed of approximately 100 community volunteers who had relevant professional ties and technical expertise. These groups developed, and in 2008 submitted to the Mayor and City Council, KCMO's first climate protection plan and Greenhouse Gas Emissions Inventory. Based on recommendations in the Plan, the City Council unanimously adopted an ambitious

GHG mitigation goal to achieve reductions equating to 30 percent below 2000 levels by 2020, both from city government operations and the community as a whole. A second "aspirational" community-wide goal aims to achieve an additional 50 percent reduction by 2050.

KCMO's GHG Mitigation Activities

As is the case with many cities, KCMO's greenhouse gas inventory and its subsequent update has proven a useful tool to assess emissions, identify the sectors responsible for them, and develop targeted mitigation strategies. According to its initial inventory, KCMO released 9.57 million tons CO_2e in 2000, rising to 9.95 million tons CO_2e in 2005, or approximately 22.39 tons per capita. Commercial and residential buildings (45 percent), transportation (36 percent), and industry (16 percent) were the largest contributing sectors to this total. Approximately three percent of the city's total emissions came from municipal government operations (KCMO 2008).

In order to turn planning into action, the climate action plan identified 55 policy activities that the City could pursue to reduce emissions and, to the extent possible, projected the likely impact associated with their implementation (KCMO 2008). The actions were linked to two different phases, the first of which focused internally on city government operations and the second which expanded on the first and focused on emissions from the larger community. For example, Phase 1 recommendations included that the city government meet five percent of its total electricity consumption with renewable energy for a projected annual reduction of 13,450 tons CO_2e. The associated Phase 2 recommendation increased the goal to 20 percent by 2015 to achieve an additional reduction of 21,900 tons CO_2e annually. This prompted building retrofits and the installation of solar and wind energy generating units on fire stations, parking garages, and other municipal buildings. A related Phase 2 recommendation called for the promotion of community-wide energy conservation and renewable electricity use by private entities in the city. Despite comprising only a small portion of the community total, the city government opted to first pursue relatively ambitious reduction targets for its own municipal operations. This decision reflected a belief that the city government should lead by example, that a higher level of control could be exerted over its own emissions, and that work was already underway which could facilitate the achievement of these objectives (KCMO 2008).

The initial GHG inventory suggested, and a second inventory conducted in 2013 confirmed, that buildings account for a disproportionately large

percentage of KCMO's total community-wide emissions (KCMO 2016). Electricity use in buildings has been described as "the elephant in the room" in terms of KCMO's GHG emissions and has thus received more attention as a target for mitigation than other sectors (Martel and Shechter 2015). EnergyWorks KC was a $20 million program launched to address the approximately 24 percent of community-wide emissions coming from residential buildings. Like programs in many cities across the United States, EnergyWorks KC was supported by the American Recovery and Reinvestment Act of 2009 and concluded in 2014 when funding expired. The program resulted in almost 3000 energy efficiency improvement projects across all building types, yielding emissions reduction estimated at 70,000 tons CO2e per year. KCMO's efforts at reducing emissions from the buildings sector were strengthened by its selection as one of the ten cities in the country to participate in the City Energy Project, a three-year initiative intended to increase energy efficiency in large buildings. As part of its participation in the Project, the City employed a series of regulatory and voluntary mechanisms including passing more stringent building codes and reporting requirements, promoting energy reduction challenges, and administering education campaigns.

Particularly since 2011, the KCMO city government has placed a strong emphasis on data collection and sharing. This organizational priority is epitomized by KCStat, "a data-driven, public-facing initiative focused on improving the efficiency and effectiveness of city services" that aligns with the City's 5-year business plans (KCMO 2016). Reflecting the local government's data-driven culture, city staff will use software to track energy consumption and progress toward its energy and GHG goals for a portfolio of over 200 municipal buildings and approximately 1500 of the largest non-municipal buildings in the city on a detailed building-by-building basis. To facilitate this data collection, the City adopted an Energy Empowerment Ordinance in 2015, which is a benchmarking and transparency policy for building-level energy and water consumption. This policy enables the City to more accurately and comprehensively measure progress toward its building energy reduction goals. The policy applies to municipal buildings over 10,000 square feet and institutional, commercial, industrial, and multi-family buildings over 50,000 square feet. Building owners are required to report to the City using the Energy Star Portfolio Manager software, and the City is required to publicly release the data.

In addition to its efforts on buildings, the KCMO city government has also targeted GHG emissions from on-road transportation. A major effort in this sector is a new streetcar, which opened for ridership in 2016. Although only 2.2 miles long, it is free to use and travels along a congested downtown

corridor and may pave the way for additional rail transit in the city, powered by electricity. The City has also transitioned 345 vehicles in its government fleet to operate on compressed natural gas, propane, or electricity and is implementing a bicycle network called Bike KC with 600 miles of on-street bicycle facilities, including lanes, trails, routes, and right-of-ways.

KCMO's progress on achieving its intended emissions reductions has been mixed. Between 2005 and 2013, community-wide emissions have decreased an average of one percent annually, equating to four percent below year 2000 baseline levels. Although it reflects progress, the City is not yet on track to meet its community-wide abatement goal of a 30 percent reduction by 2030. However, many of its major activities in both the building and transportation sectors are quite recent and may take more time to reach their full potentials. The City is achieving mitigation targets for its own governmental operations: the 2013 greenhouse gas emissions estimate shows municipal emissions at 25 percent below the 2000 baseline, which is close to the 2030 goal with time to spare.

Lessons Learned

Although Kansas City, Missouri, may not be one of the nation's top leaders in climate protection and GHG management, it could certainly vie for the title of "most improved." Over the past decade, KCMO has advanced from being a laggard on basic green measures to being a serious actor in the local climate protection movement. A review of its experiences suggests the importance of policy and political entrepreneurs, resources and institutional support, and community partners. In the academic literature, policy and political entrepreneurs are characterized by their investments of time and energy toward advancing policies that they believe are particularly important. They have "skin in the game" and are distinguished by the public nature of their roles. Whereas policy entrepreneurs are government employees who often work internally and behind the scenes, political entrepreneurs are elected officials and take a more visible approach. Previous studies have identified both roles as important in facilitating the adoption of subnational climate policies across the United States (Rabe 2004; Hughes 2016). The KCMO experience appears consistent with this trend. The mayor, city manager, and chief environmental officer all acted as entrepreneurs during the initiation of the city's GHG initiatives in 2005–2006, and those efforts have benefitted from consistency in subsequent support. The chief environmental officer has remained in his position for the past decade, and the City's next two mayors and city manager

continued to prioritize environmental efforts. Related to this, the City's climate initiatives have benefitted from relatively stable institutional support in the form of human and financial resources. The Office of Environmental Quality, which has an annual budget of around $1 million, has two dedicated full-time staff that work on sustainability and coordinate the city's GHG reduction efforts along with multiple other environmental initiatives. The Office has another five full-time staff that work on environmental regulation, including pollution prevention, hazardous waste management, asbestos assessment and abatement in municipal buildings, lead dust cleanup, and worker environmental protection. Additionally, leadership by the City's elected officials and senior management has empowered staff in all City departments to incorporate GHG reductions and sustainability into every aspect of their work.

Support from community partners and key stakeholders also proved important to the City's efforts and were actively cultivated during the initial climate planning process. The Chamber of Commerce and local investor-owned electric utility company, Kansas City Power and Light (KCP&L), were particularly targeted for engagement by city staff. The Chamber synergistically established a Climate Partnership Program as a means to deploy ideas on climate protection to local businesses and provide a formal venue to represent local business interests in state and municipal policy development. Also influential was KCP&L's commitment to increase renewables in its energy production fuel mix, which lowers the City's overall carbon intensity per energy unit and contributes to reaching local climate protection goals. KCP&L's efforts are also compliant with the state's renewable portfolio standard which requires 15 percent of electricity demand to be met by renewables by the year 2021. The City's mitigation activities and progress toward its goals have been significantly enhanced by the efforts of community partners, utilities, and other governments.

Challenges and Barriers

A review of the KCMO experience with GHG management reveals several sets of challenges which can be placed under the categories of technical, financial, institutional, and political. Collecting the detailed, reliable, consistent emissions data at regular intervals that is needed to support a GHG management program is a primary technical challenge. Although the KCMO city government prioritizes data and data-driven decisions, the burden of collecting it remains. Gathering the data needed to conduct a greenhouse gas

inventory requires months of coordination with departmental staff and external organizations such as local utility companies and planning organizations. The data often spans multiple software and database systems, requiring strong data collection and management expertise to ensure legitimacy of the results. Moreover, calculating changes in emissions over time becomes difficult when accepted approaches or software are modified, requiring backcasting of the old data to new methodologies. KCMO undertook this backcasting process when it transitioned from using purchased ICLEI software to a propriety tool developed for KCMO's own internal use. Finally, data aggregation can be a challenge, particularly in multi-tenant buildings, which challenges the initiation of data-driven building efficiency improvements. To overcome data aggregation obstacles, KMCO participated in the Energy Data Accelerator, a two-year partnership with the Department of Energy and KCP&L in 2014–2015. An outcome was regulatory approval from the state public utility commission to allow the utility to aggregate energy consumption data for buildings over 50,000 square feet with five or more tenants. This policy advancement was critical for success of the benchmarking and transparency policy, and GHG emissions reduction communitywide.

A second set of challenges are financial and institutional in nature. Many of these challenges manifest in the budgeting process and in the interdepartmental negotiations that are a part of it. As described by KCMO Mayor Sly James "The budget is ground zero for tough decisions. Needs must be met. Wants would be nice. Facts and data are a must." (James 2016). Streetlights offer one simple example where institutional and budgetary considerations hindered effective GHG management in KCMO. The 2013 GHG emissions inventory shows that the Public Works department was responsible for 23 percent of emissions from municipal operations. Much of this was due to streetlights and traffic lights. While most of the City's traffic signals have been converted to LEDs that significantly reduce energy consumption and utility costs, under the current payment structure, the City pays a flat per-light rate to the electric company for its streetlights, meaning that any energy efficiency retrofits made to streetlights will not result in utility cost savings for the City. With a highly constrained budget, energy efficiency improvements must yield a payback to have any hope of being accepted during departmental budget negotiations. This type of financial arrangement—whether flat rates or split incentives—can pose serious challenges to even "common sense" emissions reduction activities. When assessing potential opportunities to reduce emissions, it is important to be able to foresee and overcome financial and institutional barriers, which may involve small—but often stubborn—internal adjustments to "the way things have always been done."

A third set of challenges are political. As a liberal city in a conservative state, the local government walks a fine line on many issues between advancing its priorities and staying under the radar of state-level opposition. The threat of state preemption is always looming and recently came to a head over the City's individual earnings tax, a one percent local tax levied on wages earned in KCMO. Although the state has not yet acted to block any of KCMO's climate protection or energy efficiency efforts, doing so would not be without precedent. For example, at the time when commercial building energy benchmark policies were beginning to diffuse throughout the country, the Arizona state legislature adopted and the governor signed a law prohibiting local governments from mandating energy reporting from commercial buildings. In such a context, policymakers and staff must develop a keen sense of how far they can push a policy without backlash.

Further Reading

IPCC. Climate Change 2014: Synthesis Report Summary for Policymakers. IPCC. Geneva, Switzerland. Available at: https://www.ipcc.ch/pdf/assessment-report/ar5/syr/AR5_SYR_FINAL_SPM.pdf.

Portney, Kent E. 2013. *Taking Sustainable Cities Seriously: Economic Development, the Environment, and Quality of Life in American Cities*. MIT Press. Cambridge, MA.

Wolinsky-Nahmias, Yael. 2015. *Changing Climate Politics*. Los Angeles: CQ Press.

References

Allen, Monica. Greenhouse Gas Benchmarked Reached. *National Oceanic and Atmospheric Administration*, 6 May 2015. http://research.noaa.gov/News/NewsArchive/LatestNews/TabId/684/ArtMID/1768/ArticleID/11153/Greenhouse-gas-benchmark-reached-.aspx. Accessed 18 Dec 2015.

Betsill, Michele, and Harriet Bulkeley. 2007. Looking Back and Thinking Ahead: A Decade of Cities and Climate Change Research. *Local Environment* 12 (5): 447–456.

Bird, Lori, Caroline Chapman, Jeff Logan, Jenny Sumner, and Walter Short. 2011. Evaluating Renewable Portfolio Standards and Carbon Cap Scenarios in the US Electric Sector. *Energy Policy* 39 (5): 2573–2585.

Bulkeley, Harriet, and Vanesa Castán Broto. 2013. Government by Experiment? Global Cities and the Governing of Climate Change. *Transactions of the Institute of British Geographers* 38 (3): 361–375.

Bulkeley, Harriet, Heike Schroeder, Katy Janda, Jimin Zhao, Andrea Armstrong, Shu Yi Chu, and Shibani Ghosh. 2009. Cities and Climate Change: The Role of Institutions, Governance and Urban Planning. *Change* 28: 30.

California Air Resources Board. 2014. *Climate Change Scoping Plan*. http://www.arb.ca.gov/cc/scopingplan/2013_update/first_update_climate_change_scoping_plan.pdf. Accessed 20 July 2016.

Carley, Sanya, and Tyler R. Browne. 2013. Innovative US Energy Policy: A Review of States' Policy Experiences. *Wiley Interdisciplinary Reviews: Energy and Environment* 2 (5): 488–506.

Center for Climate and Energy Solutions. 2016. *Multi-state Initiatives*. http://www.c2es.org/us-states-regions/regional-climate-initiatives#NA2050. Accessed 20 July 2016.

———. 2016. *KCStat*. http://kcmo.gov/kcstat/. Accessed 5 July 2016.

City of Kansas City, Missouri. 2008. *Climate Protection Plan*. http://kcmo.gov/city-managersoffice/wp-content/uploads/sites/11/2013/11/City-Climate-Protection-Plan.pdf. Accessed July 5 2016.

Dillon, Karen. 2006. Kansas City Taking First Environmental Steps. *Kansas City Star* 15 (February): 3.

Grubb, Michael J., Chris Hope, and Roger Fouquet. 2002. Climatic Implications of the Kyoto Protocol: The Contribution of International Spillover. *Climatic Change* 54 (1–2): 11–28.

Hughes, Sara. 2016. The Politics of Urban Climate Change Policy Toward a Research Agenda. *Urban Affairs Review*. https://doi.org/10.1177/1078087416649756.

ICLEI 2015. *2014 Annual Report*. Retrieved from http://icleiusa.org/wpcontent/uploads/2015/06/ICLEI_2014_ANNUAL_REPORT1.pdf.

IPCC. 2014. *Climate Change 2014: Synthesis Report*. Contribution of Working Groups I, II, and III to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change [Core Writing Team, R.K. Pachauri and L.A. Meyers (eds.)]. IPCC. Geneva, Switzerland, 151 pp.

James, Sly. Tough Choices. *Mayors Blog*, 24 March 2016. http://kcmayor.org/blog. Accessed 6 July 2016.

Krause, Rachel Marie. 2011. An Assessment of the Greenhouse Gas Reducing Activities Being Implemented in US cities. *Local Environment* 16 (2): 193–211.

———. 2012. The Impact of Municipal Governments' Renewable Electricity Use on Greenhouse Gas Emissions in the United States. *Energy Policy* 47: 246–253.

Martel, JC and Jerry Shechter. 2015. *The Elephant in the Room: Kansas City's Largest Buildings*. http://kcmo.gov/data/2015/11/18/the-elephant-in-the-room-kansas-citys-largest-buildings/. Accessed 25 July 2016.

Olson, Mancur. 1965. *The Logic of Collective Action*. Cambridge: Harvard University Press.

Ostrom, Elinor. 1990. *Governing the Commons*. Cambridge: Cambridge University Press.

Palmer, Karen, and Dallas Burtraw. 2005. Cost-effectiveness of Renewable Electricity Policies. *Energy Economics* 27 (6): 873–894.

Rabe, Barry G. 2004. *Statehouse and Greenhouse: The Emerging Politics of American Climate Change Policy*. Washington DC: Brookings Institution Press.

Rabe, Barry. 2015. A New Era in States' Climate Policies? In *Changing Climate Politics*, ed. Yael Wolinsky-Nahmias, 55–81. Los Angeles: CQ Press.

Rogelj, Joeri, Michel den Elzen, Niklas Höhne, Taryn Fransen, Hanna Fekete, Harald Winkler, Roberto Schaeffer, Fu Sha, Keywan Riahi, and Malte Meinshausen. 2016. Paris Agreement Climate Proposals Need a Boost to Keep Warming Well Below 2C. *Nature* 534: 631–639.

Salamon, Lester M., and Odus V. Elliott. 2002. *The Tools of Government: A Guide to the New Governance*. Oxford: Oxford University Press.

Semple, Robert B. California Leads the Way on Climate Change. *New York Times*, 14 October 2015. http://takingnote.blogs.nytimes.com/2015/10/14/california-leads-the-way-on-climate-change/?_r=1. Accessed 22 July 2016.

Singh, Shanna. 2005. Brandeis's Happy Incident Revisited: US Cities as the New Laboratories of International Law. *George Washington International Law Review* 37: 537.

Sippel, Maike, and Till Jenssen. *2009*. What About Local Climate Governance? A Review of Promise and Problems. *A Review of Promise and Problems 27* (*November*): 2009.

Sweet, William. A Surprising Success at Paris. *Bulletin of the Atomic Scientists*, 21 December 2015. http://thebulletin.org/surprising-success-paris9016. Accessed 22 July 2016.

UN Habitat. *Climate Change*. http://unhabitat.org/urban-themes/climate-change/. Accessed 22 July 2016.

UNFCCC. *Copenhagen Climate Change Conference – December 2009*. https://unfccc.int/meetings/copenhagen_dec_2009/meeting/6295.php. Accessed 22 July 2016.

US Census. 2010. American FactFinder. https://factfinder.census.gov/faces/nav/jsf/pages/index.xhtml.

US Conference of Mayors. *List of Participating Mayors*. http://www.usmayors.org/climateprotection/list.asp. Accessed 28 June 2016.

US EPA. 2014. *US Greenhouse Gas Inventory Report: 1990–2014*. Available: https://www.epa.gov/ghgemissions/us-greenhouse-gas-inventory-report-1990-2014.

US Environmental Protection Agency. 2016. *US Greenhouse Gas Inventory Report: 1990–2014*. http://www3.epa.gov/climatechange/ghgemissions/usinventoryreport.html. Accessed 22 July 2016.

US Environmental Protection Agency, Office of Transportation and Air Quality. 2012. *EPA and NHTSA Set Standards to Reduce Greenhouse Gases and Improve Fuel Economy for Model Years 2017–2025 Cars and Light Trucks*. EPA-420-F-12-051. https://www3.epa.gov/otaq/climate/documents/420f12051.pdf. Accessed 22 July 2016.

Wallach, Phillip A. 2012. *US Regulation of greenhouse gas emission*. Brookings Institute. http://www.brookings.edu/~/media/research/files/papers/2012/10/26-climate-change-wallach/26-climate-change-wallach.pdf.

Watts, Mark and Gino Van Begin. 7100 Cities from 119 Countries Join Together in Historic Collaboration to Accelerate Climate Action. *EcoWatch*, 23 June 2016. http://ecowatch.com/2016/06/23/global-covenant-of-mayors-for-climate-energy/. Accessed 22 July 2016.

Wolinsky-Nahmias, Yael. 2015. Introduction: Global Climate Politics. In *Changing Climate Politics*, ed. Yael Wolinsky-Nahmias, 55–81. Los Angeles: CQ Press.

8

Air Pollution and Greenhouse Gas Emissions in China: An Unsustainable Situation in Search of a Solution

Haakon Vennemo and Kristin Aunan

Background: Basic Facts About Air Pollution in China

The interested public is well aware that China has a huge air pollution problem. It is frequently reported in social media and the international press. Visitors to Chinese cities see it with their own eyes. The Chinese government is open about it. There even exist a number of apps that translate monitored data of air quality in Chinese cities into real-time readings of environmental risk, sending off green, yellow, or red signals as the case may be.

Yet basic characteristics of the problem are often left out of mass-media coverage. This chapter aims to fill in some of the characteristics. It mainly deals with responses to the problem of air pollution and greenhouse gas emissions in China. We outline trends in air pollution and greenhouse gas emissions, review policy goals and targets, and discuss policy instruments to meet those targets. However, it is necessary, to first outline basic facts of the air pollution and greenhouse gas problems.[1]

There are many types of air pollutants. Particulate matter (PM) less than 2.5 μm in diameter, called $PM_{2.5}$, is currently the most common indicator of

H. Vennemo (✉)
School of Business, OsloMet - Oslo Metropolitan University, Oslo, Norway

K. Aunan
CICERO, Oslo, Norway

R. Brinkmann, S. J. Garren (eds.), *The Palgrave Handbook of Sustainability*,
https://doi.org/10.1007/978-3-319-71389-2_8

air pollution. PM_{10}, which includes coarser particles up to 10 μm in diameter, is an older indicator. $PM_{2.5}$ has a diameter of approximately one-thirtieth the width of a human hair. We cannot see the individual particle with our eyes, but we may notice a haze when the particles are abundant. $PM_{2.5}$ can stay in the air for six months or more, and it can travel for hundreds, sometimes thousands, of kilometers. Hence $PM_{2.5}$ is a dangerous, individually invisible pollutant whose cause (emission) and effect (exposure, inhalation, and damage) are separated in time and space.

The weak connection between cause and effect is further complicated by the fact that $PM_{2.5}$ is not always emitted as $PM_{2.5}$. PM that is directly emitted is called *primary* PM. PM that is formed in the atmosphere from gaseous pollutants is called *secondary* PM. Usually, primary particles from combustion processes, and secondary particles, are the smallest and more of them belong in the $PM_{2.5}$ category. Primary particles from industrial processes and road and soil dust are coarser and more of them belong in the PM_{10} category. In China an increasing fraction of the particulate air pollution is secondary particles, as primary PM is being abated to a larger extent than PM precursors (Zhao et al. 2013b; Zhang and Samet 2015).

In order to comprehensively reduce $PM_{2.5}$ in the air, one must address the sources of secondary PM. The main sources of secondary PM are sulfur dioxide (SO_2), nitrogen oxides (NO_x), volatile organic compounds (VOCs), and ammonia (NH_3). All of these, and of course, primary PM as well, must be taken down in a wide area for PM control to stand a chance.

The most important environmental consequence of $PM_{2.5}$ is arguably that it increases mortality risk. Because of the small size of $PM_{2.5}$, it can be inhaled deep into the lungs where it impairs respiratory function. It can also enter the bloodstream, where it causes cardiovascular complications. $PM_{2.5}$ is associated with increased mortality rates for cardiovascular diseases, cancers, strokes, and other common causes of death. A huge number of studies in different climates, living conditions, and so on, including many Chinese studies, have confirmed that both short-term exposure to elevated $PM_{2.5}$ episodes and long-term exposure to chronically elevated $PM_{2.5}$ increase the frequency of mortality from these diseases as well as the frequency of people living with the diseases (WHO 2006). In fact, the number of links between $PM_{2.5}$ and health conditions keeps growing all the time. Recent links include diabetes, neurodevelopment, and cognitive impairment (WHO 2013 or Calderon-Garciduenas et al. 2014).

There are several attempts at estimating the number of people who die prematurely from $PM_{2.5}$ exposure each year in China (Cao et al. 2011; Rohde

and Muller 2015). The Global Burden of Disease project provides comparable estimates of deaths attributable to a range of risk factors across the globe, including air pollution (Lim et al. 2012).[2] The most recent update from this study finds that 1.6 million people in China died in 2016 as a result of air pollution, as shown in Table 8.1. This death toll manifests itself through higher incidence of common causes of death. Hence it is difficult to spot on the ground and must be deducted from statistical analysis. The 1.6 million figure includes about 600,000 who died from indoor air pollution related to smoke from burning wood and coal for cooking and heating, and 1,100,000 who died from ambient air pollution. In addition, around 70,000 are estimated to die from ozone pollution. Ozone pollution is a consequence of emissions of NO_x and VOC (in the presence of sunlight), that is, two of the compounds that make secondary PM, and gives a double reason for controlling these pollutants.

Although it is difficult to draw the connection in time and space between PM exposure and its sources, the compounds that together form $PM_{2.5}$ can in many regions be attributed to a common main source—coal.[3] Combustion of coal, whether in tiny household stoves, small industrial boilers, big industrial facilities, or huge power plants, leads to emissions of primary PM and most of the compounds that form secondary PM. There are several abatement technologies available to reduce emissions, and one of the environmental successes of China in recent years is that more and more chimneys are equipped with abatement technologies, while several small sources including coal burning in household stoves have been prohibited in some areas. We will discuss that in more detail below. But coal remains a major cause of PM pollution in China, which now consumes more than half of all the coal in the world (51 percent according to BP, 2016). This huge amount of coal consumption also explains why China is by far the world's largest source of greenhouse gas emissions.

In summary, some basic background facts about air pollution in China are as follows:

Table 8.1 Premature deaths from air pollution in China 2016

Cause	Annual deaths per 100,000 people	Total
Ambient (outdoor) $PM_{2.5}$ pollution	78.0	1,100,000
Household (indoor) air pollution from solid fuels	43.9	600,000
Ambient ozone pollution	5.1	70,000
Total	114.3	1,600,000

Source: IHME (2017). There were 1.39 billion people in China in 2016

1. Small particles measured as $PM_{2.5}$ are the main indicator of air pollution to worry about in context of health damage.
2. PM comes in two varieties: Primary PM is emitted as PM. Secondary PM is formed from emission of SO_2, NO_x, and other compounds.
3. $PM_{2.5}$ increases mortality and morbidity risks for a range of common diseases.
4. About 1.60 million people are estimated to die prematurely from air pollution in China every year.
5. The main source of PM pollution in ambient air in China is coal combustion.
6. Burning of biomass and coal in simple household stoves also constitutes an important health risk, primarily in rural and peri-urban areas.
7. Coal combustion is the reason behind China's status as the world's highest GHG emitter.

Distribution of Air Pollution Across China

Estimates of consequences of air pollution rely on modeling and measurement of exposure to polluted air. A standard metric is population-weighted concentration. The nation-wide, population-weighted mean annual concentration of $PM_{2.5}$ in ambient (outdoor) air in China is currently estimated at about 55–60 micrograms per cubic meter ($\mu g/m^3$) (Zhang and Cao 2015; Brauer et al. 2016). By comparison, the corresponding figure in Western Europe and North America is below 15 $\mu g/m^3$ (EEA 2015). The WHO air quality guideline, which is set to reduce health risks to a minimum for all, including sensitive individuals, is 10 $\mu g/m^3$. Intermediate targets are suggested for developing countries.

The annual average of $PM_{2.5}$ indicates the magnitude of the air pollution problem in China. The average however hides large spatial and seasonal variations. In fact, the provinces in the east and north, which contain main centers of population and industry, fare much worse than the provinces in the south (Fig. 8.1).

In the worst-hit regions, which include the capital Beijing and neighboring provinces, including Hebei province, the annual $PM_{2.5}$ concentration exceeds 90 $\mu g/m^3$ in large areas. Regarding soot particles (or black carbon, a $PM_{2.5}$ component formed by incomplete combustion and suspected to be more toxic than the average PM particle), it is estimated that the average population-weighted exposure in the North China plain and the Sichuan basin is about *ten times* higher than in Europe and North America (Wang et al. 2014).

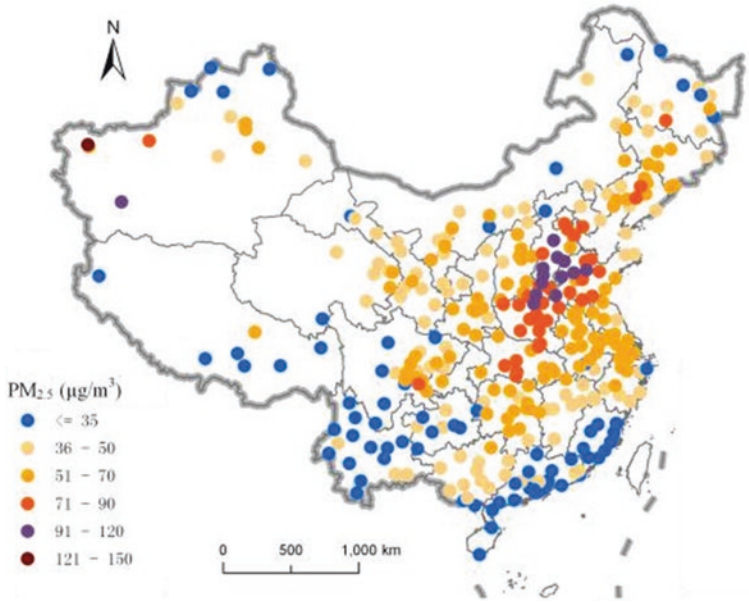


Fig. 8.1 Annual average $PM_{2.5}$ concentrations in China in 2015

Trends in Air Pollution

When assessing the situation, a question of interest is whether air pollution has become worse over time. Unfortunately, $PM_{2.5}$ was not regularly and broadly monitored in China before 2013 and it is difficult to compare current air pollution to that of previous years. It is still only monitored in urban areas. PM_{10}, which we recall consists of $PM_{2.5}$ and coarser particles, has been monitored for a longer time. The data indicates that urban levels of PM_{10} have in fact decreased substantially in the period from around 2000 to 2012 in the North, while there is a small increase in the South. This suggests that the situation has improved. On the other hand, secondary PM has increased over time in China, and is particularly high during high pollution episodes (Huang et al. 2014). This modifies the conclusion from the PM_{10} data. A study of $PM_{2.5}$ hot spots indicated a small increase in $PM_{2.5}$ over the period 2004–2013 (Ma et al. 2016). All in all, it is premature to conclude that dangerous $PM_{2.5}$ ambient air pollution levels are coming down in China, but they do not seem to increase either. The geographical variation is large.

So far, we have described trends in ambient air pollution. But as mentioned above the Global Burden of Disease study and WHO find that household air pollution (which permeates the air not only indoors but also

locally in the village or neighborhood) is a related, important cause of premature mortality in China. Moreover, household air pollution occurs disproportionally in rural areas, in the poorer segments of the population. In fact, emissions from household stoves are also an important contributor to ambient air pollution in many regions (Liu et al. 2016; Chafe et al. 2014).

At the time of the population census in 2010, 600 million Chinese relied on solid fuels (wood, crop residues, and/or coal) for heating and cooking. Burning wood, crop residues, and coal in simple household stoves means that combustion is incomplete and some of the fuel carbon is converted to particles, carbon monoxide, and a range of toxic organic components (Naeher et al. 2007). The particle exposure that results is uncertain, but available data indicate an annual $PM_{2.5}$ average among those who rely on solid fuels of 150–300 $\mu g/m^3$ (Aunan et al. 2017). This may be compared to the ambient average in China of about 55–60 $\mu g/m^3$ and that WHO considers anything above 10 $\mu g/m^3$ to be a health risk. Thus, for populations that rely on solid fuels, exposure to indoor air pollution is a much more serious problem than ambient air pollution. If a household that relies on solid fuels is situated in an urban area, it may suffer a double burden of heavy indoor and outdoor pollution.

Fortunately, household air pollution is a decreasing problem in China. Census data show that during 2000–2010, around 250 million Chinese switched from coal and firewood to electricity and gas. Both general economic developments including urbanization, and, to a more limited extent, specific public policies such as a fairly successful subsidy program for biogas digesters in rural areas and banning of the use of coal stoves in urban areas have contributed to this decrease.

Greenhouse Gas Emissions

We also describe greenhouse gas emissions. Figure 8.2 shows that China's greenhouse gas emission more than doubled from 2001 to 2013, the most recent year of these records. By 2005, EU and US emissions were surpassed, and by 2013 China's greenhouse gas emissions were larger than those of the EU and the USA combined. In terms of per capita values, Chinese greenhouse gas emissions are still lower than those of the USA, but they are equal to emissions in the EU. Moreover, EU and US emissions have a stable to declining trend.

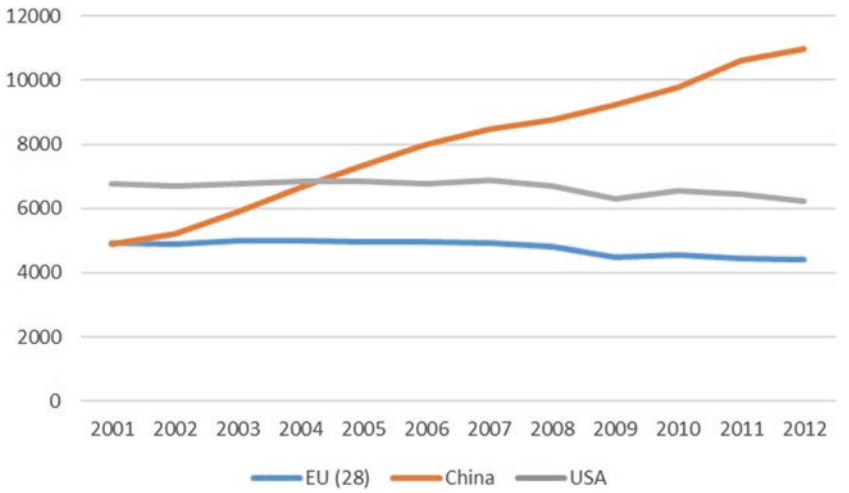


Fig. 8.2 Greenhouse gas emissions in China, USA and EU (28) from 2001 to 2012. Source: WRI CAIT Database (WRI 2017). Total GHG emissions excluding land use change and forestry (MtCO2e)

Ambitions and Goals

Ambitions and goals for air pollution control in China are articulated in the State Council (2013), Air Pollution Prevention and Control Plan, and the NPC (2016) 13th Five-Year Plan.[4] The State Council (2013) plan is designed to reduce emissions of all the main air pollutants that directly or indirectly contribute to exposure to $PM_{2.5}$. The plan points out that controlling air pollution is "a herculean task", but "the whole society should work together for fresh air and strive for economic development in the course of environmental protection, and environmental protection in the course of economic development". Concretely the plan requires "inhalable particulate matter" to decline by ten percent by 2017 compared with 2012. The annual concentration of "fine particulate matter" in Beijing-Tianjin-Hebei Provinces, the Yangtze River Delta, and the Pearl River Delta should decline 25 percent, 20 percent, and 15 percent, respectively. The annual concentration of fine particulate matter in Beijing should be below 60 $\mu g/m^3$.

These are ambitious goals, at least when comparing with the first year of regular measurement, that is, 2013. Recall that there are no official measurements from 2012, which gives authorities some freedom in assessing results. The target for Beijing, which is formulated in $\mu g/m^3$ as opposed to percentage improvement, may be the most ambitious of all. The $PM_{2.5}$ level of Beijing was 80–90 $\mu g/m^3$ in the period 2013–2015, and $PM_{2.5}$ concentrations in the capital will thus need to go down up to 50 percent by 2017. Currently it is

not clear how that is to be achieved. In early 2018 it was reported that the target was, in fact, achieved, but partly because of favourable weather. The 25 percent reduction goal for the Beijing-Tianjin-Hebei region may not be sufficient. Beijing-Tianjin-Hebei is the region of brown and purple dots in the east of China in Fig. 8.1.

The NPC (2016) 13th Five-Year Plan restates targets for urban air quality in slightly different terms than State Council (2013). Instead of percentage improvement in annual concentration, it states that the number of days when $PM_{2.5}$ exceeds allowable limits should be reduced to 18 percent. It also gives targets for *emissions* of SO_2, NO_x, NH_3, and VOC. As noted, these are the main precursors to secondary $PM_{2.5}$. The plan requires SO_2 and NO_x emissions to decline by 15 percent and NH_3 and VOC to decline by ten percent over the five-year period 2016–2020. The 13th Five-Year Plan also contains a cap on total energy consumption in 2020 (five billion tons coal equivalents (or TCE)). Current energy consumption is significantly less (4.3 billion TCE). Still the "coal cap" represents a new way of thinking in addressing the main source of SO_2, NO_x, and PM emissions. The coal cap is also going to be important for China's greenhouse gas emissions, where the voluntary commitment by China to the United Nations Framework Convention on Climate Change (UNFCCC) is to peak carbon emissions by 2030 and also make its "best efforts" to peak earlier.

Prior to the State Council (2013) plan and the new 13th Five-Year Plan, the Chinese government had less focus on air quality and greenhouse gas emissions. The focus was on reducing emissions of some air pollutants through the policy of total emissions control. The list of pollutants to control has changed over time, and it never contained $PM_{2.5}$. The one pollutant that has consistently been targeted is sulfur dioxide (SO_2), and in all likelihood SO_2 emissions in China peaked a few years ago.[5] Scrubbers and other abatement technologies to limit SO_2 are available, and they are applied in power plants and large industrial sources. Direct emissions of particulate matter in the form of "smoke and dust" were subject to total emission control up to 2005, and abatement technologies such as electrostatic precipitators (ESP) have been implemented in most power plants and large industrial sources.[6] The period 2011–2015 introduced emission targets for NO_x and ammonia nitrogen, with the result that de-NO_x abatement technologies are being installed on large point sources and NO_x emissions are leveling off. In fact, State Council (2016) reports NO_x emissions to have gone down 19 percent over the five-year period 2011–2015, a good deal more than the target of eight percent reduction. The same source says that SO_2 has gone down 18 percent and NH_3 13 percent over five years, both exceeding ambitions (Seligsohn 2016).

Here are key observations:

1. Targets for air quality improvements could be more difficult to reach than targets for emission reductions. The air quality targets that are formulated in terms of concentration levels (μg/m^3) or number of days without exceeding may be particularly difficult. The Beijing concentration target of less than 60 μg/m^3, for example, translates to almost 50 percent improvement compared to the level today. Even if emission reductions in the range of 20 percent are achieved as planned, the air quality target will be far from achieved.
2. Targets for $PM_{2.5}$ concentrations are particularly hard to reach. This is both due to the dislocation in time and space between emission source and effect in the air, and to the complicated chemistry that forms secondary PM. The complicated chemistry is shown by the fact that NH_3 was acknowledged as an important contributor to secondary $PM_{2.5}$ only a few years ago. Moreover, it is likely that a reduction of NO_x may render SO_2 reduction less efficient in reducing secondary $PM_{2.5}$.
3. Even if environmental targets for air pollution in China are met, the problem is still of a considerable size and the damage in terms of excess mortality and other consequences will persist for many years to come.
4. The voluntary Chinese commitment for greenhouse gas emissions is significantly higher than current consumption.

Policy Instruments and Implementation

The State Council (2013) plan contains ten broad policy measures ranging from a rephrased statement of aims (e.g., the first measure is to "enhance the overall treatment and reduce discharges of multiple pollutants") to general support for improved legal, monitoring, and market-based frameworks and support for public participation. The idea, which is common in Chinese policy making, is that such broad statements should inspire and guide local governments and enterprise leaders to make detailed policies of the desired nature.

In fact, in recent years, the incentives for local leaders to adhere to national environmental policy goals are strengthened. Since 2016, local leaders' promotion prospects to some extent depend on whether they deliver local air quality improvements and emission reduction in their jurisdictions. Local leaders in China are evaluated by their superiors using a "balanced score card", and it is this scorecard that has been extended to air quality. The State Council (2016) has added that those who violate environmental regulations and those

who fail to report violations will be "severely punished". In previous years, local leaders were held responsible by way of the scorecard for indicators of emissions and energy efficiency. In reality they were not much responsible for the environment at all. The targets were not important enough ("hard" in Chinese parlance), and post-2008 economic growth came back as the overriding concern. Research by Zhang et al. (2011) describes how the system worked in one Chinese province. Wu et al. (2014) show that in the years 2001–2009 in close to 300 main cities in China both the party secretary and the mayor were less likely to be promoted if they spent a larger share of the city's income on environmental improvement. Hence, if the stated emphasis on environmental performance is implemented in practice, it is an important change.

Given the long-range transport of $PM_{2.5}$ far from the site of origin, controlling air quality at the local level is no easy task. As a general rule, emissions from surface-level sources such as transport exhaust, industries with low stacks, and household stoves improve air quality at the local level the most, and it is those sources that local leaders have instruments to address. In Beijing, for example, city leaders have responded by prohibiting cars from driving one workday a week and by building more public transportation. During periods of bad air quality cars are prohibited from driving every other day. During special events, such as the World War II 70th anniversary military parade in 2015, the city may require that the surrounding provinces implement temporary emission control at thousands of factories, power plants, and construction sites. In general, however, it is a likely short-term consequence of the incentive system that local sources of air quality improvements will be emphasized, while regional sources such as power plant emissions from high stack will be emphasized less. Over the long term, the government may see the value of cooperation to reduce regional sources.

Chinese environmental and energy policy highlights technical regulations, standards, and prohibitions, so-called command-and-control policies. For example, the State Council (2013) document mentions that polluting vehicles (so-called yellow-label vehicles) and old vehicles should be prohibited and the quality of fuel oil should be upgraded. Cooking fume pollution from the catering services should be controlled (which is unlikely to have a large impact on air quality in the country). In addition, the document emphasizes that the implementation of abatement technologies for SO_2, NO_x, and PM should continue. Another policy mentioned in the document is to force inefficient production facilities in heavy industry and power production to close. Like abatement, this policy has been going on for some time and with good results. For instance, the average efficiency of Chinese coal fired power plants is currently higher than that of US power plants (Seligsohn et al. 2009).

While the command-and-control policy is prominent, the use of economic regulation, also called incentive based regulation, is notably absent from the environmental policy mix in China at the local as well as central level. For example, visitors to China will notice that the prices posted on billboards at gas stations are close to world market prices of gasoline—they do not include any gasoline taxes. Actually, the prices are set by administrative decree, which means they are not guaranteed to even reflect upturns in world market prices. The prices of electricity are also set by administrative decree and do not necessarily reflect upturns in underlying prices of coal, the main fuel. Certainly, they do not reflect the environmental cost of electricity production. The low and regulated prices on gasoline and electricity make it harder to attain environmental goals since they remove the possibility of influencing the millions of consumers and firms who, on a daily basis, decide whether to take the car or use the bus, use air conditioning in every room, and so on. Low prices encourage excess gasoline and electricity consumption.

Indeed, in China in the past few years the low price of electricity and the priority given to economic growth are major drivers behind the enormous growth in coal consumption that has propelled China's greenhouse gas emissions far past those of the USA. We will now try to explain the economic mechanisms that have driven the growth in coal consumption (Vennemo et al. 2009a, b). The point of departure is again to note that local leaders have been rewarded for economic growth in their jurisdiction. The surest way to guarantee growth has been to set up a heavy industry factory, producing things like iron and steel, cement, or petrochemicals. The factories have been financed by accumulated earnings of previous factories and by household savings. Households seldom invest directly, but banks and informal lending institutions channel their savings to investment. Both corporate savings (retained earnings) and household savings are much higher in China than in Western countries, giving space for this investment.

Part of the production from the new factories has gone into infrastructure in China, such as roads, airports, and railways. Another part has been used for construction of housing. Yet other parts have been used for building yet more new factories, whether to produce consumption goods for the world market or a new round of heavy industry. Prices of outputs have been high and the market has accommodated growth in production. At the same time the price of electricity has been low by regulation and a huge consumption of electricity has not increased cost to the same degree.

All this made the new heavy industry factories profitable, confirming the initial presumption of local leaders that they would generate new income, that is, economic growth. For years, economic growth in China was like a golden

circle: The output of new factories was used to build the next generation of factories and to build the infrastructure that could transport the goods that were produced.

But lately the growth model of previous years has come under pressure, to the benefit of the environment. The logic of exponential growth is such that a constant percentage growth rate requires more and larger new factories over the course of time. If one factory is sufficient during the first year, a local leader who requires ten percent growth per year will have to invest in a ten per cent larger factory the next year. Unless prices are growing or a new and more productive technology is found, investment and saving will have to grow ten percent as well. As people who receive the income will be ten percent richer next year, they must save a constant share of income in order to save ten percent more.

Three things have happened recently to put pressure on this model: First, the Chinese government wants to increase the rate of consumption at the expense of saving and investment. This shift from investment to consumption is the core of the "new normal", a term coined by Chinese policy makers in 2014 to indicate a shift toward consumption, and a lower rate of growth. The new normal is by general agreement a good thing since the rate of saving in China is unnecessary high. Saving and investment is in reality a transfer from the present generation that saves, to future generations that consume the results of saving, but future generations in China are likely to be more affluent anyway. A somewhat lower rate of saving alleviates this problem, but it leaves less investment resources with which to maintain the former rate of growth.

Second, the Chinese government has decided to let prices of key inputs such as electricity and gasoline be determined by market forces. In the best case it will mean that carbon prices from an emission trading system, of which there are pilots running in China, will translate into higher prices of electricity, fuel, and other carbon intensive goods. This will make heavy industry a less profitable investment asset.

Third, the golden circle of higher production, higher demand, and higher prices has been broken. This circle was shaken in 2008 by the global financial crisis. The Chinese government responded with a huge stimulus package to increase demand, but eventually capacity in heavy industry has just become too big when the lack of foreign demand also is taken into consideration. With less need for steel and cement to build new factories, demand has fallen even more. The result is that as of 2016 there is significant overcapacity in industries like steel and power. The central government has told 15 provinces (out of 31 in total) to stop building new power plants, and several provinces led by Hebei Province bordering Beijing have been told to reduce steel

production capacity. It may be noted that Hebei is in the center of the region with the worst air quality, as shown in Fig. 8.1.

This threefold pressure on the growth model has slowed down economic growth, and coal consumption has leveled out. World steel prices have rebounded. Some researchers have observed that coal consumption has in fact peaked 15 years prior to the date promised to the UN (Qi et al. 2016) but that could be a premature conclusion. From the available data on underutilization of capacity, it is likely that the Chinese economy at present is operating at less than full capacity while it tries to shift to a new growth model that relies less on investment and more on consumption. When capacity utilization increases, coal consumption may increase again. It will require an active use of the price mechanism, along with continued command-and-control policy, to stem the demand impulse from a growing economy. Meanwhile the global climate (CO_2) and Chinese citizens ($PM_{2.5}$) will get some breathing space.

Lessons Learned

The case study on air pollution and greenhouse gas emissions in China offers some valuable insights into the race between unsustainable economic growth and initiatives to support sustainability:

1. *Awareness*: In recent years, the Chinese government and the Chinese public have become more aware of the dangers of $PM_{2.5}$. This statement has at least two aspects. One is that scientific knowledge has penetrated Chinese policy circles, shifting attention to $PM_{2.5}$ from other pollution compounds. Another is the interplay between publication of $PM_{2.5}$ air quality data in several hundred cities, an action that was sanctioned by the government, and the increase in awareness in the public that puts pressure on the government to do more. Meanwhile, with respect to greenhouse gases, the Chinese government has over time acknowledged more responsibility than it did before.
2. *Promotion to depend on environmental progress*: In the decentralized Chinese system the incentives of local leaders for promotion are important instruments in policy implementation (Xu 2011). That is why it was significant that environmental investment did not support promotion prospects in the period 2001–2009 (Wu et al. 2014) and why it is significant that new, environmental criteria are now emphasized. However, the actual emphasis on these criteria will only be known in the coming years.

3. *Abatement technologies are penetrating the country*: China has made significant progress in making use of state-of-the-art abatement technologies for SO_2 and NO_x, which are important precursors to $PM_{2.5}$, and in PM itself. Its coal fired power plants are quite efficient, and so is some of its industry. It is building wind and solar power plants in greater quantities than other countries (although not in relative terms). It is likely that China has turned a corner and ambient $PM_{2.5}$ levels will go down in the years to come. Indoor air pollution will also become a smaller problem as urbanization and modernization continues.

Challenges and Barriers

While $PM_{2.5}$ levels may be coming down, they are still too high. Current policies are not sufficient since they do not address coal consumption in an effective manner and also leave gasoline consumption unhindered. The leveling off in coal consumption and CO_2 emissions that is currently seen could be related to the fact that the Chinese economy is operating at less than full capacity and not to purposeful environmental policy. The following are significant challenges:

- *Prices of key resources are still set by administrative decree.* Since prices are set by the government, there is no direct link between, for example, an increase in the price of coal or oil and domestic prices of electricity and gasoline.
- *Environmental costs are not allowed to influence prices of energy.* In theory China could use its administrative capacity to raise the end user prices of energy. However, this does not happen in practice. Were a carbon trading system to be comprehensively introduced in China, for example, it is an open question whether prices of carbon intensive energy goods would be allowed to increase in price to the relevant degree.
- *Environmental levies are unpopular.* Environmental levies are rather unpopular in China and/or authorities allow the unpopularity to be voiced. In Beijing, for example, few officially complain about the even-odd number plate system despite its rigid nature and obvious costs to convenience, but a proposal to introduce a congestion fee has met significant open protest (Hao 2016).
- *Fuel switching does not occur fast enough.* If environmental levies had been in place that punished coal for its environmental cost, and those levies had been allowed to roll unhindered through the economy, China would in all

likelihood experience fuel switch from coal to natural gas. Such a fuel switch is the main reason why Europe and the USA have experienced relative success in reducing $PM_{2.5}$ and leveling off CO_2 emissions. Without a pressure through prices and profitability, China is slow to embrace natural gas. A pipeline is currently being built from Russia and will improve matters in the long run.

The synthesis of these challenges to sustainability is that China so far does not use the price mechanism to support stated environmental goals. China is still searching for a solution to its unsustainable air pollution problem.

Notes

1. Greenhouse gas emissions are not strictly air pollution. Greenhouse gases affect the global climate, but by air pollution we mean dirty air that potentially damages health and ecosystems. Hence we distinguish between air pollution and greenhouse gas emissions.
2. See also the web pages of the World Health Organization (WHO) http://www.who.int/healthinfo/global_burden_disease/about/en/ and the Institute of Health Metrics and Evaluation http://vizhub.healthdata.org/gbd-compare/.
3. Some may protest that traffic is a main source of one of the compounds, NO_x. But that seems so far not to be the case in China, see, for example, Zhao et al. (2013a).
4. http://english.mep.gov.cn/News_service/infocus/201309/t20130924_260707.htm English translation, see: www.cleanairchina.org/file/loadFile/27.html.
5. The measurement of national emissions is surprisingly difficult. It requires quality monitoring of actual emissions from thousands, if not millions, of stacks as well as accounting precisely for the chemical content of energy sources, for example, how much sulfur in coal. In the case of NO_x it requires information on the properties of combustion (e.g., the furnace heat) as well. NH_3 is emitted from the fields in agriculture and depends on fertilizer use, and from the decomposition of livestock manure, both of which are difficult to quantify precisely. VOC is fugitive; it slips away, for example, from gasoline pumps and is not easily measured. In practice any estimate of emissions of air pollutants is uncertain. The change in emissions may be somewhat more certain as one may assume that some sources of uncertainty cancel.
6. A different and even more effective technology called fabric filter seems to be used less.

Further Reading

Trends in Chinese air pollution, its consequences and drivers in the 90's and 00's are discussed in Vennemo et al. (2009a, b). Consequences of current air pollution are described in Kan et al. (2012), and Zhang and Samet (2015). The potential impacts of making use of environmental economic instruments in the form of a price on carbon emissions and levy on fossil energy are discussed and quantified in Aunan et al. (2007), Vennemo et al. (2009a, b) and Nielsen and Ho (2013).

References

Aunan, Kristin, Ma Qiao, Marianne T. Lund, and Shuxiao Wang. 2017. An Integrated Approach to Estimating the Population-Weighted Exposure to PM2.5 Pollution Across China. Submitted.

Aunan, Kristin, Terje Berntsen, David O'Connor, Therese Hindman Persson, Haakon Vennemo, and F. Zhai. 2007. Benefits and Costs to China of A Climate Policy. *Environment and Development Economics* 12 (3): 471. https://doi.org/10.1017/s1355770x07003610.

BP. BP Statistical Review of World Energy 2016. 2016. http://www.bp.com/en/global/corporate/energy-economics/statistical-review-of-world-energy.html.

Brauer, M., G. Freedman, J. Frostad, A. van Donkelaar, R.V. Martin, F. Dentener, Dingenen Rv, K. Estep, H. Amini, J.S. Apte, K. Balakrishnan, L. Barregard, D. Broday, V. Feigin, S. Ghosh, P.K. Hopke, L.D. Knibbs, Y. Kokubo, Y. Liu, S. Ma, L. Morawska, J.L. Sangrador, G. Shaddick, H.R. Anderson, T. Vos, M.H. Forouzanfar, R.T. Burnett, and A. Cohen. 2016. Ambient Air Pollution Exposure Estimation for the Global Burden of Disease 2013. *Environmental Science & Technology* 50 (1): 79–88. https://doi.org/10.1021/acs.est.5b03709.

Calderon-Garciduenas, Lilian, Ricardo Torres-Jardon, Randy J. Kulesza, Su-Bin Park, and Amedeo D'Angiulli. 2014. Air Pollution and Detrimental Effects on Children's Brain. The Need for a Multidisciplinary Approach to the Issue Complexity and Challenges. *Frontiers in Human Neuroscience* 8: 613. https://doi.org/10.3389/fnhum.2014.00613.

Cao, J., C. Yang, J. Li, R. Chen, B. Chen, D. Gu, and H. Kan. 2011. Association Between Long-term Exposure to Outdoor Air Pollution and Mortality in China: A Cohort Study. *Journal of Hazardous Materials* 186 (2–3): 1594–1600. https://doi.org/10.1016/j.jhazmat.2010.12.036.

Chafe, Zoe A., Michael Brauer, Zbigniew Klimont, Rita Van Dingenen, Sumi Mehta, Shilpa Rao, Keywan Riahi, Frank Dentener, and Kirk R. Smith. 2014. Household Cooking with Solid Fuels Contributes to Ambient PM Air Pollution and the Burden of Disease. *Environmental Health Perspectives*. https://doi.org/10.1289/ehp.1206340.

EEA. Air quality in Europe – 2015 Report. 2015. *Publications Office of the European Union*. Luxembourg: European Environment Agency.

Hao, Feng. 2016. Beijingers Skeptical of Plans for a Congestion Charge. *Chinadialogue*. https://chinadialogue.net/article/show/single/en/9080-Beijingers-sceptical-of-plans-for-a-congestion-charge. Accessed 25 Aug 2016.

Huang, Ru-Jin, Yanlin Zhang, Carlo Bozzetti, Kin-Fai Ho, Jun-Ji Cao, Yongming Han, K.R. Daellenbach, J.G. Slowik, S.M. Platt, F. Canonaco, P. Zotter, R. Wolf, S.M. Pieber, E.A. Bruns, M. Crippa, G. Ciarelli, A. Piazzalunga, M. Schwikowski, G. Abbaszade, J. Schnelle-Kreis, R. Zimmermann, Z. An, S. Szidat, U. Baltensperger, El Haddad, and André S. Prevot. 2014. High Secondary Aerosol Contribution to Particulate Pollution During Haze Events in China. *Nature* 514 (7521): 218–222. https://doi.org/10.1038/nature13774.

IHME. Global Burden of Disease. 2016. *University of Washington, Institute for Health Metrics and Evaluation*. 2017. http://vizhub.healthdata.org/gbd-compare/. Accessed October 2, 2017.

Kan, H., R. Chen, and S. Tong. 2012. Ambient Air Pollution, Climate Change, and Population Health in China. *Environment International* 42: 10–19. https://doi.org/10.1016/j.envint.2011.03.003.

Lim, S.S., T. Vos, A.D. Flaxman, G. Danaei, K. Shibuya, H. Adair-Rohani, et al. 2012. A Comparative Risk Assessment of Burden of Disease and Injury Attributable to 67 Risk Factors And Risk Factor Clusters in 21 Regions, 1990–2010: A Systematic Analysis for the Global Burden of Disease Study 2010. *Lancet* 380 (9859): 2224–2260. https://doi.org/10.1016/S0140-6736(12)61766-8.

Liu, Jun, Denise L. Mauzerall, Chen Qi, Qiang Zhang, Yu Song, Wei Peng, Zbigniew Klimont, Xinghua Qiu, Shiqiu Zhang, Hu Min, Weili Lin, Kirk R. Smith, and Tong Zhu. 2016. Air Pollutant Emissions from Chinese Households: A Major and Underappreciated Ambient Pollution Source. *PNAS*. https://doi.org/10.1073/pnas.1604537113.

Ma, Zongwei, Xuefei Hu, Andrew M. Sayer, Robert Levy, Qiang Zhang, Yingong Xue, Shilu Tong, Jun Bi, Lei Huang, and Liu Yang. 2016. Satellite-Based Spatiotemporal Trends in PM2.5 Concentrations: China, 2004–2013. *Environmental Health Perspectives* 124 (2): 184–192. https://doi.org/10.1289/ehp.1409481.

Naeher, Luke P., Michael Brauer, Michael Lipsett, Judith T. Zelikoff, Christopher D. Simpson, Jane Q. Koenig, and Kirk R. Smith. 2007. Woodsmoke Health Effects: A Review. *Inhalation Toxicology* 19 (1): 67–106. https://doi.org/10.1080/08958370600985875.

Nielsen, Chris, and Mun Ho, eds. 2013. *Clearer Skies Over China. Reconciling Air Quality, Climate, and Economic Goals*. Cambridge, MA: MIT Press.

NPC. 2016. *13th Five Year Plan*. National People's Congress. http://news.xinhuanet.com/politics/2016lh/2016-03/17/c_1118366322.htm.

Qi, Ye, Nicholas Stern, Tong Wu, Jiaqi Lu, and Fergus Green. 2016. China's Post-coal Growth. *Nature Geoscience* 9 (8): 564–566. https://doi.org/10.1038/ngeo2777.

Rohde, R.A., and R.A. Muller. 2015. Air Pollution in China: Mapping of Concentrations and Sources. *PLoS One* 10 (8): e0135749. https://doi.org/10.1371/journal.pone.0135749.

Seligsohn, Deborah. *How China's 13th Five-Year Plan Addresses Energy and the Environment*. Testimony Before the U.S.-China Economic and Security Review Commission. 27 April 2016. http://www.uscc.gov/sites/default/files/Deborah%20Seligsohn_Written%20Testimony%20042716.pdf.

Seligsohn, Deborah, Robert Heilmayr, Xiaomei Tan, and Lutz Weischer. 2009. *WRI Policy Brief. China, the United States, and the Climate Change Challenge*. http://www.wri.org/publication/china-united-states-and-climate-change-challenge.

State Council. 2016. *Report on the Work of the Government*. Delivered at the Fourth Session of the 12th National People's Congress of PR China. http://www.china.org.cn/china/NPC_CPPCC_2016/2016-03/18/content_38056401.htm

Vennemo, H., K. Aunan, H. Lindhjem, and H.M. Seip. 2009a. Environmental Pollution in China: Status and Trends. *Review of Environmental Economics and Policy* 3 (2): 209–230. https://doi.org/10.1093/reep/rep009.

Vennemo, H., K. Aunan, Jianwu He, Tao Hu, and Shantong Li. 2009b. Benefits and Costs to China of Three Different Climate Treaties. *Resource and Energy Economics* 31 (3): 139–160. https://doi.org/10.1016/j.reseneeco.2009.03.003.

Wang, Rong, Shu Tao, Yves Balkanski, Philippe Ciais, Olivier Boucher, Junfeng Liu, Shilong Piao, H. Shen, M.R. Vuolo, M. Valari, H. Chen, Y. Chen, A. Cozic, Y. Huang, B. Li, W. Li, G. Shen, B. Wang, and Yanyan Zhang. 2014. Exposure to Ambient Black Carbon Derived from a Unique Inventory and High-resolution Model. *Proceedings of the National Academy of Sciences*: 2459–2463. https://doi.org/10.1073/pnas.1318763111.

WHO. 2006. *Air Quality Guidelines. Global Update 2005*. Copenhagen: WHO Regional Office for Europe. http://www.who.int/phe/health_topics/outdoorair/outdoorair_aqg/en/.

———. 2013. *Review of Evidence on Health Aspects of Air Pollution – REVIHAAP Project Technical Report*. Copenhagen: WHO Regional Office for Europe.

WRI. 2017. *CAIT Climate Data Explorer*. World Resources Institute. http://cait.wri.org/historical. Accessed 2 October 2017.

Wu, Jing, Youngheng Deng, Jun Huang, Randall Morck, and Bernard Yeung. 2014. Incentives and Out-comes: China's Environmental Policy. *Capitalism and Society* 9 (1): Article 2. https://papers.ssrn.com/sol3/papers.cfm?abstract_id=2399048

Xu, C.G. 2011. The Fundamental Institutions of China's Reforms and Development. *Journal of Economic Literature* 49 (4): 1076–1151. https://doi.org/10.1257/jel.49.4.1076.

Zhang, Yan-Lin, and Fang Cao. 2015. Fine Particulate Matter (PM2.5) in China at a City Level. *Nature, Scientific Reports* 5: 14884. https://doi.org/10.1038/srep14884.

Zhang, Junfeng (Jim), and Jonathan M. Samet. 2015. Chinese Haze Versus Western Smog: Lessons Learned. *Journal of Thoracic Disease* 7 (1): 3–13. https://doi.org/10.3978/j.issn.2072-1439.2014.12.06.

Zhang, Daisheng, Kristin Aunan, Hans Martin Seip, and Haakon Vennemo. 2011. The Energy Intensity Target in China's 11th Five-Year Plan period—Local Implementation and Achievements in Shanxi Province. *Energy Policy* 39 (7): 4115–4124. https://doi.org/10.1016/j.enpol.2011.03.085.

Zhao, B., S.X. Wang, H. Liu, J.Y. Xu, K. Fu, Z. Klimont, J.M. Hao, K.B. He, J. Cofala, and M. Amann. 2013a. NOx Emissions in China: Historical Trends and Future Perspectives. *Atmospheric Chemistry and Physics* 13 (19): 9869–9897. https://doi.org/10.5194/acp-13-9869-2013.

Zhao, B., Shuxiao Wang, Xinyi Dong, Jiandong Wang, Lei Duan, Fu Xiao, Jiming Hao, and Fu. Joshua. 2013b. Environmental Effects of the Recent Emission Changes in China: Implications for Particulate Matter Pollution and Soil Acidification. *Environmental Research Letters* 8 (2): 024031. https://doi.org/10.1088/1748-9326/8/2/024031.

9

Waste Management Outlook for the Middle East

Salman Zafar

Background

The Middle East is one of the most prolific waste-generating regions of the world, mainly on account of high rate of population growth, urbanization, and economic expansion (Table 9.1). The fast and accelerating consumption rates have led to a rapid increase in the generation of a wide array of urban wastes. Waste is not only a serious environmental and public health hazard but is also a major economic issue as a major portion of city's municipal budget is spent on waste management.

The inefficient and reckless use of scarce natural resources, reflected in materials discarded as garbage, represents a huge environmental and economic cost borne by the society as a whole. It can create severe health problems linked to the production of malodorous compounds, proliferation of insects, rodents, vermin and pathogens, occurrences of spontaneous fires, contamination of soil and water, and emissions of toxic gases. Municipal waste also contributes to climate change due to large-scale emission of potent greenhouse gases (GHGs), like methane and carbon dioxide, from landfills and waste dumps.

High-income countries in the Middle East, such as Saudi Arabia, the United Arab Emirates (UAE), Qatar, Bahrain, and Kuwait, are counted among the world's largest per capita waste generators (Abou-Elseoud 2008). The gross

S. Zafar (✉)
Founder, EcoMENA, Doha, Qatar

R. Brinkmann, S. J. Garren (eds.), *The Palgrave Handbook of Sustainability*,
https://doi.org/10.1007/978-3-319-71389-2_9

Table 9.1 Solid waste generation in major Middle East nations

Country	Population (millions)	MSW generated (kg per person per day)	Gross MSW generation (million tons per year)
Bahrain	1.4	2.70	1.5
Saudi Arabia	32	1.80	15.0
UAE	9.3	1.7	6.6
Kuwait	4.4	1.40	2.0
Qatar	2.6	1.80	2.5
Oman	4.5	1.2	1.7
Jordan	8.0	0.90	2.0
Iraq	37	1.4	11.3
Egypt	95	0.80	20.0

urban waste generation in Middle Eastern countries has exceeded 150 million tons per year (Zafar 2015a). The growing waste management problem has forced policy-makers and urban planners to explore sustainable waste management solutions, including recycling and waste-to-energy. The per capita production of municipal waste in top Middle Eastern cities, such as Riyadh, Doha, Abu Dhabi, and Dubai, is more than 1.5 kg per day which is among the highest worldwide (Zyoud et al. 2015). Across the region, the recycling sector is underdeveloped and hardly 10–15 percent of the waste is recycled (Zafar 2015b).

The management of solid waste is a challenge faced by all modern societies and the Middle East is not an exception. However, waste is not only a challenge; it is also an untapped industry and an opportunity. In addition to avoiding the negative impacts associated with trash, waste management presents an attractive economic opportunity through the recovery of material resources (plastics, papers, metals, etc.) and energy (fuel, heat, and power). However, in order to reap the benefits of waste, it has to be treated as a resource and not as a liability.

Key Challenges in Waste Management

Waste management has become a challenging issue for Middle Eastern countries. In the Gulf Cooperation Council (GCC) subregion (Fig. 9.1), where most of the countries have high GDP rates, the scale of the challenge faced by civic authorities is even bigger.

The key factors responsible for growing waste crisis in the Middle East include lavish lifestyles, ineffective legislations, infrastructural roadblocks, indifferent public attitude, and lack of education and environmental awareness. Due to lack of garbage collection and disposal facilities, dumping of waste in open spaces, deserts, and water bodies is a common sight across the

Fig. 9.1 Map of the Middle East. The countries marked in green constitute the GCC regional block (Source: http://meconstructionnews.com/wp-content/uploads/2011/08/GCC-map.jpg)

region. High standards of living are contributing to generation of more garbage which when coupled with lack of waste collection and disposal facilities have transformed trash into a liability.

Waste as Liability

In the Middle East, the general perception toward trash is that of indifference and apathy. In other words, waste is usually treated as waste rather than as a resource. Unfortunately, none of the countries in the region have an effective source-segregation mechanism. Biodegradable matter, recyclables, and non-recyclables are usually collected in a single bag by households and other waste generators which are collected in a standard garbage truck and dumped in landfills. It is to be noted that once the waste gets mixed, it is difficult, time-consuming, and expensive to separate it into organic and inorganic fractions. There is an urgent need to increase public awareness about environmental

issues, waste management practices, and sustainable living. Public participation in community-level waste management initiatives is lackluster mainly due to low level of environmental awareness and public education.

Lack of Frameworks

Many regional countries lack legislative framework and regulations to deal with wastes. Insufficient funds, absence of strategic waste management plans, lack of coordination among stakeholders, shortage of skilled manpower, and deficiencies in technical and operational decision-making are some of the hurdles experienced in implementing an integrated waste management strategy in the region. Lack of reliable institutional solid waste management (SWM) framework for the collection, transport, and disposal of urban wastes is a big hurdle in the development of waste management sector.

Dominance of State-Owned Companies

In most of the Middle Eastern countries, waste management is the sole prerogative of state-owned companies and municipalities which discourage participation of private companies and entrepreneurs. Municipal solid waste (MSW) management, considered as free public service in most of the region, is directly controlled by government agencies, thus resulting in situations where financial incentives cannot be leveraged to improve and modernize solid waste management services.

Lack of Information and Data

Another important issue which is hampering the progress of Middle East waste management sector is the lack of reliable sectorial data and information such as rate of generation of different waste streams, scenarios of treatment, growth rate of solid waste, infrastructural requirements, and so on, all of which are critical for developing MSW management strategy in a particular country.

Obsession with Landfills

Around half of the solid waste stream in the Middle East is made up of organic materials, while the rest comprises recyclables like plastics, papers, and metals. However, the predominant method of waste disposal is landfilling. It is to be

noted that a vast majority of landfills in the Middle East are simply waste dumps. A waste dump, also known as non-sanitary landfill, is a huge tract of land where municipal solid waste is dumped without any consideration for human and environmental health. Waste dumps are characterized by spontaneous fires, continuous emissions of toxic gases, contamination of water bodies, damage to soil and ecosystems, and health hazards for people living in the vicinity. In land-scarce countries like Qatar, Kuwait, and Bahrain, landfilling is certainly not a good option as these countries are finding it very difficult to site new landfills due to improper waste management and public health concerns. For example, most of the landfills in Kuwait have been surrounded by domestic and commercial establishments due to rapid urban development over the years.

Absence of Recycling Infrastructure

In general, Middle East has inadequate waste management infrastructure and lackluster waste disposal capabilities. Due to the absence of source segregation and lack of material recovery facilities (MRFs), the recovery rate of recyclables is abysmally low. Since recycling centers are very few, the majority of the collected waste is dumped into the landfills. In fact, the economics of recycling is unfavorable in the Middle East due to lack of recycling centers, underdeveloped market for recycled products, and dismal public awareness about the importance of 3Rs of waste management—reduce, reuse, and recycle (Mani 2016).

Positive Developments

In recent years, several countries, like Qatar and the UAE, have established ambitious solid waste management projects but their efficacy is yet to be ascertained. On the whole, Middle Eastern countries are slowly, but steadily, gearing up to meet the challenge posed by waste management by investing heavily in such projects, sourcing new technologies, and raising public awareness. However, the pace of progress is not matched by the increasing amount of waste generated across the region.

During the last few years, the UAE, Qatar, Saudi Arabia, and Kuwait have unveiled multi-billion-dollar investment plans to improve waste management scenario. In particular, the establishment of Domestic Solid Waste Management Centre in Qatar has catalyzed public interest in deployment of recycling and waste-to-energy systems in the Middle East.

The largest waste management company in the Middle East, Bee'ah, has set up a Materials Recovery Facility in Sharjah, UAE's third most populous city, which is the largest in the Middle East and third largest in the world. This specialized facility sorts and separates recyclable materials from municipal solid waste, through mechanical and manual processes. With an annual capacity of 500,000 tons, the MRF is currently processing 900 tons of general waste, of which an estimated 60 percent can be recycled and thus diverted from the landfill.

Qatar was the first Middle Eastern country to implement a waste-to-energy project program and currently generates over 30 MW of electricity from its Domestic Solid Waste Management Centre (DSWMC) located at Mesaieed (Doha). Saudi Arabia and the UAE have both been exploring waste-to-energy production capacity targets of 100 MW. Bahrain, Kuwait, and Oman are also seriously considering waste-to-energy as a means to tackle the worsening waste management problem. Abu Dhabi's government is currently spending around US $850 million to build a 100-MW plant which is expected to be operational by 2017 and which will supply around 20,000 households with electricity (Waste Management World 2014).

Waste management is a serious issue in all countries in the Middle East, irrespective of economic status. High waste growth rate and shrinking natural resources have made sustainable waste management a highly challenging task for countries ranging from super-rich Qatar to impoverished Yemen. In the following paragraphs, we will examine waste situation in key countries of the Middle East and explore how respective governments are trying to deal with the growing waste crisis.

Case Studies

Kingdom of Saudi Arabia

The Kingdom of Saudi Arabia, the most populous country in the Middle East, has been witnessing rapid industrialization, high population growth rate, and fast urbanization which have resulted in increased generation of all kinds of waste, including municipal waste, construction waste, industrial waste, and hazardous waste.

With population of around 32 million, Saudi Arabians produce more than 15 million tons of solid waste per year. The per capita waste generation is estimated at 1.5–1.8 kg per day (Zafar 2015d). In Saudi Arabia, more than 75

percent of the population is concentrated in urban areas. Solid waste generation in the three largest cities—Riyadh, Jeddah, and Dammam—exceeds 6 million tons per annum which gives an indication of the enormity of the problem faced by civic bodies (Zafar 2015d). The typical composition of Saudi Arabian MSW is food waste (40–51 percent), paper (12–28 percent), cardboard (7 percent), plastics (5–17 percent), glass (3–5 percent), wood (2–8 percent), textile (2–6 percent), metals (2–8 percent), and so on, depending on the urban activities and population density of studied region (Nizami 2016). The high composition of food waste makes Saudi Arabian MSW a good feedstock for biological treatment techniques like composting and anaerobic digestion.

Waste Management Scenario

Saudi waste management system is characterized by lack of waste disposal facilities and absence of tipping fees. The garbage is collected from individual or community bins and disposed of in landfills or dumpsites. Most of the landfills are expected to reach their capacities within the next ten years. In Saudi Arabia, the landfill requirement is very high, about 28 million m^3 per year (Nizami 2015). Due to the lack of sanitary landfill facilities, many cities are experiencing environmental and health issues such as groundwater contamination, toxic emissions, and spontaneous fires. However, in many cities, the plans of new sanitary landfills are in place or are being built by municipalities with leachate collection and methane capture facilities.

Recycling, reuse, and energy recovery is still at an early stage, although they have been getting increased attention in recent years (Dhawi 2016). Waste sorting and recycling are driven by an active informal sector (Alnuwairan 2015). Recycling rate ranges from 10 to 15 percent, mainly due to the presence of the informal sector which extracts paper, metals, and plastics from municipal waste. Recycling activities in the Kingdom are mostly manual and labor-intensive. Recycling of metals and cardboards is the main recycling practice, which covers 10–15 percent of the total waste. Waste pickers or waste scavengers take the recyclables from the waste bins and containers in cities (Zafar 2015d).

Based on the energy conservation concept, it is estimated that 45,000 TJ of energy can be saved by recycling only glass and metals from municipal solid waste in Saudi Arabia (Nizami 2016). Composting is also gaining increased interest in Saudi Arabia due to the high organic content of MSW (around 40 percent). All activities related to waste management are coordinated and financed by the government.

National Waste Management Strategy

The Saudi government is aware of the critical demand for waste management solutions and is investing heavily in solving this problem. Concerted efforts are underway to improve recycling and waste disposal activities. Recently, the Saudi Government approved new regulations to ensure an integrated framework for the management of municipal wastes. In Saudi Arabia, a systematic introduction of modern waste management techniques like material recovery facilities, waste-to-energy systems, and recycling infrastructure can significantly improve waste management scenario and can also generate good business opportunities. Strong legislations, financial support, public awareness, modern technologies, and stakeholders' participation should be the key in transforming Saudi Arabia into a "green" nation.

State of Qatar

Qatar, one of the world's richest countries, is facing serious environmental challenge in the form of waste management. With a total population of around 2.6 million, Qatar produces more than 2.5 million tons of municipal solid waste each year. The country has one of the highest per capita waste generation rates worldwide of 1.8 kg per day (Zafar 2016d). Across the country, around 8000 tons of waste is produced every day. Solid waste stream mainly comprises organic materials (around 60 percent), while the rest of the waste steam is made up of recyclables like glass, paper, metals, and plastics (Suresh 2017).

State of the Affairs

Municipalities are responsible for solid waste collection in Qatar both directly, using their own logistics, and indirectly through private sector contract. Waste collection and transport is carried out by a large fleet of trucks that collect MSW from thousands of collection points scattered across the country.

The predominant method of solid waste disposal is landfilling. The collected waste is discharged at various transfer stations from where it is sent to the landfill. There are three landfills in Qatar; Umm Al-Afai for bulky and domestic waste, Rawda Rashed for construction and demolition waste, and Al-Krana for sewage sludge. However, the method of waste disposal by landfill is not a practical solution for a country like Qatar where land availability is limited, and hardly 10–15 percent of the waste is recycled (Zafar 2016d).

National Waste Management Strategy

Qatar is adopting a multi-faceted strategy to contain the levels of waste generated by households, commercial sites, and industry—and to promote recycling initiatives. Qatar is striving to implement integrated waste hierarchy of prevention, reduction, reuse, recycling, energy recovery, and as a last option, landfill disposal (Suresh 2017).

A comprehensive solid waste management plan is being implemented which will coordinate responsibilities, activities, and planning for managing wastes from households, industrial and commercial establishments, and the construction industry. The target is to recycle 38 percent of solid waste, up from the current 8 percent, and reduce domestic per capita waste generation. Five waste transfer stations have been set up in South Doha, West Doha, Industrial Area, Dukhan, and Al-Khor to reduce the quantity of waste going to Umm Al-Afai landfill. These transfer stations are equipped with material recovery facility for separating recyclables such as glass, paper, aluminum, and plastic (Zafar 2016d).

Domestic Solid Waste Management Centre

One of the most promising waste management initiatives in the Middle East has been the establishment of Domestic Solid Waste Management Centre (DSWMC) at Mesaieed (Doha). This center is designed to maximize recovery of resources and energy from waste by installing state-of-the-art technologies for separation, pre-processing, mechanical and organic recycling, and waste-to-energy and composting technologies.

The Way Forward

While commendable steps are being undertaken to handle solid waste, the government should also strive to enforce strict waste management legislation and create mass awareness about four Rs of waste management—reduce, reuse, recycle, and recovery. Legislation is necessary to ensure compliance, failure of which will attract a penalty with spot checks by the government body entrusted with its implementation.

Improvement in curbside collection mechanism and the establishment of material recovery facilities and recycling centers may also encourage public participation in waste management initiatives. When the Qatar National

Development Strategy 2011–2016 was conceived, the solid waste management facility plant at Mesaieed was a laudable solution, but its capacity had been overwhelmed by the time the project was completed. Qatar needs several such centers to tackle the burgeoning garbage disposal problem (Suresh 2017).

The center in Mesaieed can treat only 1550 tons of the 7000 tons generated daily and this is only going to increase in the future (Suresh 2017).

Sultanate of Oman

Waste management is a challenging issue for the Sultanate of Oman because of limited land availability, high per capita waste generation, and scarcity of modern waste disposal sites. With a population of almost 4.5 million inhabitants, Oman generates more than 1.7 million tons of garbage every year. As per official statistics, the average per capita waste generation is around 1.2 kg per day, though unofficial estimates suggest a higher figure. On a daily basis, Oman produces more than 4700 tons of municipal waste (Zafar 2016c).

State of the Affairs

Most of the collected solid waste is sent to authorized (as well as unauthorized) dumpsites for disposal which is creating environmental and health issues. There are several dumpsites which are located in the midst of residential areas or close to catchment areas of private and public drinking water bodies.

The solid waste management scenario in Oman is marked by lack of collection and disposal facilities. Solid waste, industrial waste, e-wastes, and so on are deposited in scores of landfills scattered across the country. Oman has around 350 landfills/dumpsites which are managed by municipalities. In addition, there are numerous unauthorized dumpsites in Oman where all sorts of wastes are recklessly dumped (Zafar 2016c).

In Oman, solid waste is characterized by high percentage of recyclables, primarily paper and cardboard (15 percent), plastics (20.9 percent), metals (1.8 percent), and glass (4 percent). However, the country is yet to realize the recycling potential of its municipal waste stream with current recycling being a dismal 10 percent (Zafar 2016c). Recycling efforts in Oman have until now been scattered and uncoordinated. So far, all recycling programs have been initiated by private entities such as schools, businesses, charitable organizations, and non-profit environmental groups (Hakam 2016).

Al Amerat Landfill

Al Amerat landfill is the first engineered sanitary landfill in Oman which began its operations in early 2011. The landfill site, spread over an area of 9.1 hectares, consists of five cells with a total capacity of 10 million m^3 of solid waste. Each cell has 16 shafts to take care of leachate. All the shafts are interconnected in order to facilitate movement of leachate to the leachate pump. The project is part of the government's initiatives to tackle solid waste in a scientific and environment-friendly manner. Being the first of its kind, Al Amerat sanitary landfill is an example for the future solid waste management projects in the country.

Future Planning

Solid waste management is among the top priorities of Oman government which has chalked out a robust strategy to resolve waste management problem in the Sultanate. The country is striving to establish 13 engineered landfills and 36 waste transfer stations in different parts of the country by 2015. Some of the engineered landfills that are in construction phase include Al-Multaqa, Tahwa, Izz, Barka, and Thumrait landfills (Zafar 2016c)

Modern solid waste management facilities are under planning in several wilayat, especially Muscat and Salalah. The new landfills will eventually pave the way for closure of authorized and unauthorized garbage dumps around the country (Zafar 2016c).

Currently, the government is trying to develop optimal framework for the sector (policies, legislation, strategies, and plans), improve public awareness of waste management, establish recycling mechanisms and waste value recovery, closure and rehabilitation of dumpsites, develop and commercialize waste stream systems, and recover wealth from waste (Hakam 2016).

State of Kuwait

Kuwait, one of the richest countries, is also counted among the highest per capita waste generators in the world. A recent World Bank report observed that Kuwait produces around 5.72 kg of waste per person every day, the second highest in the world after Trinidad and Tobago (Hoornweg and Bhada-Tata 2012). Each year more than two million tons of solid waste is generated in the tiny Arab nation with a population of around 4.4 million. High standards of

living, rapid economic growth, and rampant consumerism have been major factors behind high per capita waste generation in Kuwait (Zafar 2015c).

Waste Management Situation

The prevalent solid waste disposal method in Kuwait is landfilling. Currently, waste management in Kuwait involves collection and transportation of waste, which is done once or twice by means of trucks. Due to the absence of source segregation, all kinds of wastes (organics as well as recyclables) are directly dumped into disposal sites. Recycling is in early stages and there are only a few recycling companies operating in the oil-rich nation.

The Scourge of Landfills

Despite being a small country, Kuwait has astonishingly high number of landfills. There are 18 landfills, of which 14 sites are closed and four sites are still in operation. Landfill sites in Kuwait are notorious for causing severe public health and environmental issues (Zafar 2015c). Besides piling up huge amounts of garbage, landfill sites generate a large amount of toxic gases (such as methane, carbon dioxide, and carbon monoxide) and are plagued by spontaneous fires. Due to fast-paced urban development, residential areas have expanded to the edges of landfill sites, thus causing grave danger to public health.

The total land area of Kuwait is around 17,820 sq. km, out of which more than 18 sq. km is occupied by landfills. Area of the landfill sites ranges from tens to hundreds of hectares with waste deposition depth varying from 3 to 30 meters. All kinds of wastes, including municipal wastes, food wastes, industrial wastes, construction, and demolition debris, are dumped at these sites (Zafar 2016b). About 90 percent of the domestic waste is sent to landfills which imply that more landfills will be required to tackle rapidly increasing volumes of solid wastes.

Most of the landfill sites have been closed for more than 20 years due to operational problems and proximity to new residential, commercial, and industrial areas. These sites include Sulaibiyah, Kabed, Al-Qurain, Shuaiba, Jleeb AI Shuyoukh, West Yarmouk, and Al Wafra, among others. Migration of leachate beyond landfill site boundaries is a frequent problem noticed across Kuwait. Groundwater contamination has emerged as a serious problem because groundwater occurs at shallow depths throughout the country. For

example, Al-Qurain landfill is located in a residential area. The area has suffered strange and intense odors as well as the occurrence of flares due to the ignition of methane gas emissions (Zafar 2016b).

The major landfill sites operated by municipality for solid waste disposal are Jleeb Al Shuyoukh, Sulaibiyah, and Al-Qurain. Most of the landfill sites have been forced to close, much before achieving their capacities, because of improper disposal methods and concerns related to public health and environment. Due to fast-paced industrial development and urban expansion, some of the landfills are located on the edges of residential neighborhoods, as is the case of Jleeb Al-Shuyoukh and Al-Qurain sites, endangering the lives of hundreds of thousands of people (Zafar 2015c).

Over the years, most of the dumpsites in Kuwait have been surrounded by residential and commercial areas due to urban development over the years. Uncontrolled dumpsites were managed by poorly trained staff resulting in transformation of dumpsites in breeding grounds for pathogens, toxic gases, and spontaneous fires. The need of the hour is to close down these non-sanitary landfills and implement a strong solid waste management framework based on the waste management hierarchy of 4Rs—reduce, reuse, recycle, and recovery (of energy).

Kingdom of Bahrain

Bahrain is an island country consisting of an archipelago of around 33 islands, the largest being the Bahrain Island. In 2016, the population of Bahrain was 1.4 million with population density of 1867 persons per km^2, which is the highest among GCC countries. Rising population, high rate of waste generation, limited land availability, scarcity of waste disposal sites, unorganized waste management sector, and poor public awareness have made solid waste management a precarious task for the Kingdom's policy-makers, urban planners, and civic authorities. The country has the distinction of being one of the highest per capita waste generators worldwide, which was estimated at 2.7 kg per day by Arab Forum for Economic Development (Abou-Elseoud 2008). In fact, Bahrain produces the largest amount of waste per person among Middle Eastern countries despite being the smallest nation in the region.

Waste Management Situation

The daily garbage production across the tiny Gulf nation is around 4500 tons (Zafar, 2014). Municipal solid waste is characterized by high percentage of organic material (around 60 percent) which is mainly composed of food

wastes. Presence of high percentage of recyclables in the form of paper (13 percent), plastics (7 percent), and glass (4 percent) makes Bahraini MSW a good recycling feedstock, though informal sectors are currently responsible for collection of recyclables and recycling activities (Zafar 2014).

The Kingdom of Bahrain is divided into five governorates, namely, Manama, Muharraq, Middle, Southern, and Northern. Waste collection, transport, and disposal operation is managed by private contractors. The prevalent solid waste management scenario is to collect unsegregated garbage and dump it at the municipal landfill site at Askar which is located 25 kilometers from the city center.

Askar, the only existing landfill/dumpsite in Bahrain, caters to municipal wastes, agricultural wastes, and non-hazardous industrial wastes. Spread over an area of more than 700 acres, the landfill has almost reached its capacity. The proximity of Askar landfill to urban habitats has been a cause of major environmental concern. Waste accumulation at Askar landfill is increasing at a rapid pace which is having serious impacts on air, soil, groundwater quality, and public health in the surrounding areas.

Future Plans

The government of Bahrain is trying hard to improve waste management situation by launching recycling initiatives, developing a large waste-to-energy project, and launching public awareness campaign. However, more efforts, in the form of effective legislations, large-scale investments, modern SWM technology deployment, and environmental awareness, are needed to implement a sustainable waste management system in Bahrain.

In Bahrain, MSW generation and its management involves severe health risks and impacts including decomposition and biodegradation of waste due to high temperatures causing obnoxious odors, proliferation of insects and rodents, occurrences of unwanted major and minor fires, contamination of soil and water by leachate generated from the landfills, emissions of toxic gases from waste disposal, burning, and incineration (Rehan 2015).

Arab Republic of Egypt

Being the most populous country in the Middle East, Egypt is grappling with the problem of solid waste management. More than 20 million tons of municipal waste is produced by the country's population of 95 million. Cairo, one of the largest cities in the world, is home to more than 15 million inhabitants.

The city produces more than 15,000 tons of solid waste every day which is putting tremendous strain on city's infrastructure (El Gazzar and Gomaa 2014). Waste collection services in Egypt are provided by the formal as well as informal sectors. While local authorities, such as the Cairo Cleanliness and Beautification Authority (CCBA), form the formal public sector, the informal public sector comprises traditional garbage collectors (the *Zabbaleen*).

The waste management situation in Egypt has assumed alarming proportions because of high population, increased waste generation, and lack of waste collection infrastructure and disposal facilities. Garbage accumulation on streets, along highways, and in waterways is a common sight. Around 60 percent of the solid waste is managed by formal as well as informal waste collection, disposal, or recycling operations. The rest is thrown on city streets or at illegal dumpsites (Zafar 2016a). The present waste management is causing serious ecological and public health problems in the country. In fact, disposal of solid waste in water bodies has led to contamination of water supplies in big cities like Cairo, Alexandria, Giza, and Port Said.

The Zabbaleen of Cairo

The *Zabbaleen*, traditional waste collectors of Cairo, have been responsible for creating one of the world's most efficient and sustainable resource-recovery and waste-recycling systems. Since the 1950s, the *Zabbaleen* have been scouring the city of Cairo to collect waste from streets and households using donkey carts and pickup trucks. After bringing the waste to their settlement in Muqattam Village, also called Cairo's garbage city, the waste is sorted and transformed into useful products like quilts, rugs, paper, livestock food, compost, recycled plastic products, and so on. After removing recyclable and organic materials, the segregated waste is passed onto various enterprises owned by *Zabbaleen* families.

The *Zabbaleen* collect around 60 percent of the total solid waste generated in Cairo and recycle up to 80 percent of the collected waste which is much higher than recycling efficiencies observed in the Western world. Over the last few decades, the Zabbaleen have refined their collection and sorting methods, built their own labor-operated machines, and created a system in which every man, child, and woman works (Zafar 2016a).

Tryst with International Companies

Believing the *Zabbaleen's* system to be backwards and unhygienic, the government in 2002 sold contracts to three multinational companies (and one local company) to collect Cairo's waste, pushing the *Zabbaleen* out of the system.

The international waste management companies started operations in Egypt, particularly Cairo, Alexandria, and Giza governorates, and the *Zabbaleen* were sidelined. However, after ten years of participation of private companies in solid waste management in Cairo, their performance was dismal. In fact, in 2009 Egyptian government acknowledged that solid waste management has deteriorated alarmingly after the entry of foreign companies.

As a result of the bad performance of multinational private sector companies in SWM in Egypt during the last decade, the level of street cleanliness deteriorated and the pollution resulting from open-burning of trash increased significantly. Moreover, the *Zabbaleen* suffered loss of livelihood after the entry of foreign solid waste management companies due to restricted access to their main asset. The mass slaughtering of pigs in 2009, after fears of swine flu epidemic led to accumulation of organic wastes in many parts of the city. The government was forced to bring back *Zabbaleen* into Cairo's waste management system in order to prevent the situation from deteriorating further (Zafar 2016a).

Hashemite Kingdom of Jordan

Jordan is one of emerging economies and is one of the most politically stable countries in the Middle East. Like other Middle Eastern nations, waste management infrastructure in the country is burdened by a fast-growing population, urbanization, and consumerism. Jordan has a population of around eight million which produces more than two million tons of solid waste each year, most of which is sent to unsanitary landfills and dumpsites for disposal. Being a relatively modest Middle Eastern country, the per capita waste generation In Jordan is 0.9 kg per day (SWEEP-Net 2014a, b).

Waste Management Situation

The predominant fraction in Jordanian MSW is organic matter which makes up as much as 50 percent of the MSW stream. The daily municipal solid waste generation is estimated at 3800 tons per day which is disposed at 24 sites across the country (Yamin 2015). Rapid increase in waste generation and improper waste disposal is leading to public health risks, adverse environmental impacts, as well as socio-economic problems, especially in big cities like Amman and Aqaba. The influx of more than a million Syrian refugees has put tremendous strain on waste management infrastructure in urban as well as rural areas of the country.

The capital city of Amman accounts for almost half of the total solid waste generated in Jordan. The Greater Amman Municipality has the duty to collect, transport, and dispose the waste at Al Ghabawi landfill site, the largest landfill in Jordan serving Amman and ten other major cities. In the coastal city of Aqaba, a private company collects and transports the waste to the landfill operated by common services council. There are 24 working landfill sites in Jordan, out of which seven are closed landfill sites (Yamin 2015).

Apart from MSW, an annual amount of 1.83 million cubic meter of septic and sewage sludge from treatment of 44 million cubic meter of sewage water is generated in Greater Amman Municipality (GAM). The potential annual sewage sludge and septic generated in Amman alone is estimated at more than 85,000 tons of dry matter (Yamin 2015).

State of the Affairs

Despite the lack of a well-defined waste management policy and legal framework, there has been good progress in the country, especially in Greater Amman Municipality, in terms of street sweeping, engineered landfilling, and service cost recovery. However, there is good deal of scope for improvement in the areas of policy, strategy, institutional setup, legal framework, and capacity building.

Insufficient financial resources, growing population, rapid urbanization, mismanagement, and lack of technical skills are some of the factors hampering the growth of waste management sector in the Hashemite Kingdom of Jordan. In general, municipalities do not have enough funds to set up modern waste collection infrastructure, recycling facilities, and waste disposal systems. Source segregation is not practiced in the country and mixed waste is collected and dumped without any treatment. Recycling, both formal and informal, is still under-developed due to lack of trained manpower and modern machinery. The role of private sector in solid waste management is also limited, except for some pilot projects.

This huge amount of waste generated in Jordan is not only a burden but a potential resource for use in energy production. The country's average waste composition is 40 percent organic waste, for example, avoidable and unavoidable food waste (1,200,000 tons); 10 percent recyclables, for example, paper, plastic, glass, ferrous metals, and aluminum (300,000 tons); and 50 percent suitable for incineration, for example, garden and park waste, wood, and textiles (1,500,000 tons) with high calorific value and energy potential (8.1 MJ/Kg) that is capable to produce 340 kWh of electricity per ton solid waste. The

high organic waste content in Jordanian MSW is suitable for anaerobic digestion which is estimated at 170 m^3 biogas for every ton of waste (Aljaradin 2016).

Rusaifeh Landfill Project

The Government of Jordan, in collaboration with United Nations Development Program (UNDP), Global Environmental Finance (GEF), and the Danish Government, established 1MW biomethanation plant at Rusaifeh landfill near Amman in 1999. The plant has been successfully operating since its commissioning and efforts are underway to increase its capacity to 5 MW. The project consists of a system of 12 landfill gas wells and an anaerobic digestion plant based on 60 tons per day of organic wastes from hotels, restaurants, and slaughterhouses in Amman (Yamin 2015).

Al Ghabawi Landfill Project

Al Ghabawi is the first engineered landfill project in Jordan, with gas collection systems, built with financial assistance from the World Bank. In fact, the project operation is the first municipal carbon finance partnership in the Middle East. The electricity generated from landfill gas will be delivered to the national grid, displacing electricity produced by grid-connected power plants that traditionally use heavy fuel oil. The Al Ghabawi landfill, consisting of nine cells, started receiving waste in 2003. Cells 1, 2, and 3 have now been filled and covered and are now closed for further waste dumping. Currently, the site receives more than 3000 tons of waste per day but LFG recovery system is yet to be implemented (SWEEP-Net 2014a, b).

Republic of Iraq

With a total population crossing 37 million, Iraq is one of the most populous Arab countries. Solid waste management has emerged as a big problem in the country due to rapid rise in population, fast economic growth, increasing individual income, and sectarian conflicts. More than 11.3 million tons of municipal solid waste is generated every year in Iraq, and Baghdad alone produces more than 1.5 million tons of garbage annually. The daily trash generation exceeds 31,000 tons at a per capita waste generation rate of 1.4 kg per day (Najjar 2016).

The waste management sector in the country is reeling under the impact of decades of mismanagement and conflicts. Most of the solid waste in Iraq is dumped in non-sanitary landfills and unregulated waste dumps across the country, without any consideration for the environment and public health. Waste dumps in Iraq are notorious for spontaneous fires, groundwater contamination, and large-scale GHG emissions.

National Waste Management Plan

The National Solid Waste Management Plan (NSWMP) for Iraq was developed in 2007 and contains the recommendations for development of the sector. The key principles of waste management strategy in Iraq is based on sustainable development, waste management hierarchy, polluter pays principle, and producer responsibility (Knowles 2009).

According to NSWMP, Iraq will build 33 engineered landfills with the capacity of 600 million m^3 in all of the 18 governorates in Iraq by 2027. The plan also focuses on the collection and transportation, disposal, and recycling systems. Social education has also been taken into consideration to ensure provision of educational system which supports the participation of both communities and individuals in waste management in Iraq.

In addition, the ministry of environment, in 2008, started its own comprehensive development program to improve environmental situation in Iraq. Ministries of Municipalities and Public Work, in collaboration with international agencies like UN Habitat, USAID, UNICEF and EU, are developing and implementing solid waste management master plans in several Iraqi governorates including Kirkuk, Anbar, Basra, Dohuk, Erbil, Sulaimaniya, and Thi Qar (Knowles 2009).

Promising Developments

Kirkuk was the first city in Iraq to benefit from solid waste management program when foreign forces initiated a solid waste management program for the city in 2005 to find an eco-friendly solution to the city's garbage collection and disposal dilemma. In early 2007, Iraq's first engineered landfill was established in Kirkuk. The 48-acre site is located 10 miles south of Kirkuk, with an expected life span of 10–12 years and meets both the US Environmental Protection Agency and European Union Landfill Directive standards.

The Iraqi city of Basra also benefited from international aid with the completion of the first landfill that is compliant with international environmental standards. Basra solid waste management program, developed by UNICEF and UN-Habitat, is not only putting together an efficient waste collection system in the city but also creating informal "recycling schools" to spread environmental awareness in the society. Basra city waste management program is part of the UNICEF program, supported by the European Union, to develop Iraq's water and sanitation sector.

The solid waste management master plan in the Kurdish city of Erbil has also been developed by UNICEF with funding from the European Union. In 2011, UNICEF has also developed a master plan to improve the management of solid waste in Dohuk Governorate. Solid waste management master plans for Anbar, Sulaimaniya, and Thi Qar governorates are also a part of UNICEF and EU efforts to attaining Iraq's Sustainable Development Goal targets of ensuring environmental sustainability (Najjar 2016).

Almost all the efforts by international organizations have been at local level and still insufficient to solve solid waste management problem in Iraq; however, these initiatives have been able to provide invaluable information regarding the size and nature of the problem and potential ways to tackle it.

Lessons Learned

The problem of waste management cannot be solved by the government authorities alone. Public awareness and behavioral change are essential as it affects people's willingness to cooperate and participate in adopting sustainable waste management practices. Basic practices like waste recycling and backyard composting can yield substantial benefits in the form of prevention of GHG emissions, reduction of pollutants, conservation of energy and resources and increase in landfill diversion rates.

The best way of dealing with waste, both economically and environmentally, is to avoid its generation. It is essential to have tool kits on waste minimization, business waste reduction, and a Waste Prevention Fund, in addition to a comprehensive plan in order to formulate policies that are in sync with the waste management hierarchy. Countries that use resources wisely, for example, Nordic and Scandinavian countries, not only save money but also have lesser impact on the environment.

The participation of local population as well as expatriates/migrants is also crucial. People should be made aware about the environmental challenges posed by increasing volumes of waste and what role a common man can play in tackling these challenges. The urgent need of the hour is to put in place an

efficient and easily accessible recycling infrastructure and to make source segregation compulsory for residential as well as commercial sectors. One of the ways to promote sustainable waste management is by promoting recycling programs and offering incentives to producers of eco-friendly products.

The Middle East is in a real need of an ambitious sustainable development agenda with waste management among its main priorities. The region can hope to improve waste management scenario by implementing source segregation, encouraging private sector participation, deploying recycling and waste-to-energy systems, and devising a strong legislative and institutional framework. In addition, a sustainable waste management system demands high degree of public participation, effective legislations, sufficient funds, and modern waste management practices and technologies.

Challenges and Barriers

Fast-paced industrial growth, a recent construction boom, increasing population, rapid urbanization, and vastly improved lifestyle coupled with unsustainable consumption patterns have all contributed to the growing waste crisis. Immediate steps are needed to tackle mountains of wastes accumulating in cities throughout the Middle East.

Waste prevention occupies the top spot in the waste hierarchy and aims to break the link between economic growth and the environmental impacts associated with the generation of waste. In the Middle East, a waste prevention plan can be a success if there is support from all stake holders.

There are people in the region from many different cultures. Middle East is a potpourri of different cultures and nationalities where many people hail from nations where recycling is already a part of daily life, while a big fraction of the people belong to countries where recycling is in early stages. One of the biggest challenges is to generate waste awareness among a transient community and to get commitment from households and businesses to participate in the local waste management initiatives.

References

Abou-Elseoud, N. 2008. Waste Management. In *Arab Environment. Future Challenges*, ed. M. Tolba, N. Saab, 111–126. Beirut: The Arab Forum for Environment and Development (AFED).

Aljaradin, Mohammad. 2016. *Waste-to-Energy in Jordan – Potential and Challenges*. December 29. http://www.ecomena.org/waste-to-energy-jordan/. Accessed 12 June 2017.

Alnuwairan, Mohammad. 2015. *Waste Management Perspectives for Saudi Arabia*. February 4. http://www.ecomena.org/swm-ksa/. Accessed 15 July 2017.

Dhawi, Faten. 2016. Recycling Attitudes in Saudi Arabia. *EcoMENA,* December 6. http://www.ecomena.org/recycling-attitudes-saudi-arabia/. Accessed 1 June 2017.

El Gazzar, R.F., and Bakr Gomaa. 2014. Municipal Waste Management in Egypt: An Investigation Study of Collection and Generation Process in Alexandria City, Egypt. *International Journal of Scientific & Engineering Research* 5 (6), 1204–1206.

Hakam, Jamila. 2016. Waste Management Perspectives for Oman. *EcoMENA,* May 9. http://www.ecomena.org/waste-oman/. Accessed 8 May 2017.

Hoornweg, Daniel and Bhada-Tata, Perinaz. 2012. *What a Waste: A Global Review of Solid Waste Management*. Washington, DC: World Bank. Number 15.

Knowles, J.A. 2009. National Waste Management Plan for Iraq. *Waste Management and Research* 27 (4): 322–327.

Mani, Izdihar. 2016. Solid Waste Management Challenges in GCC. *EcoMENA,* August 1. http://www.ecomena.org/solid-waste-management-gcc/. Accessed 10 June 2016.

Najjar, A.Y. 2016. Solid Waste Management in Iraq. *EcoMENA,* October 13. http://www.ecomena.org/swm-iraq/. Accessed 23 Apr 2017.

Nizami, A.S. 2015. Waste-to-Energy Potential in Saudi Arabia. *EcoMENA*, December 23. http://www.ecomena.org/wastetoenergy-saudiarabia/. Accessed 10 June 2017.

———. 2016. Recycling Prospects in Saudi Arabia. *EcoMENA*, January 26. http://www.ecomena.org/recycling-in-saudi-arabia/. Accessed 1 June 2017.

Rehan Ahmed. 2015. Waste Management Perspectives for Bahrain. *EcoMENA,* August 4. http://www.ecomena.org/waste-bahrain/. Accessed 18 Feb 2017.

Suresh, Surya. 2017. Waste Management Outlook for Qatar. *EcoMENA*, March 18. http://www.ecomena.org/waste-qatar/. Accessed 12 June 2017.

SWEEP-Net. 2014a. *Country Report on the Solid Waste Management in Jordan, The Regional Solid Waste Exchange of Information and Expertise Network in Mashreq and Maghreb Countries*. April. http://www.sweep net.org/ckfinder/userfiles/files/country-profiles/CountryreportJordan-En-mai2011.pdf. Accessed 25 May 2017.

———. 2014b. *Country Report on the Solid Waste Management in Morocco, The Regional Solid Waste Exchange of Information and Expertise Network in Mashreq and Maghreb Countries*. April. http://www.sweep net.org/sites/default/files/MAROC%20RA%20ANG%20WEB.pdf. Accessed 28 May 2017.

Waste Management World. 2014. *TAQA Gets into Waste to Energy – Starting with 100 MW Abu Dhabi Plant*. February 2. https://wastemanagement-world.com/a/taqa-gets-into-waste-to-energy-starting-with-100-mw-abudhabi-plant. Accessed 16 September 2017.

Yamin, M.Z. 2015. Solid Waste Management in Jordan. *EcoMENA,* January 3. http://www.ecomena.org/swm-jordan/. Accessed 25 May 2017.

Zafar, Salman. 2014. Solid Waste Management in Bahrain. *EcoMENA,* August 11. http://www.ecomena.org/solid-waste-bahrain/. Accessed 26 March 2017.

———. 2015a. *Solid Wastes in the Middle East. BioEnergy Consult*. December 12. http://www.bioenergyconsult.com/solid-wastes-in middle-east/. Accessed 20 Mar 2017.

———. 2015b. Solid Waste Management in Saudi Arabia. *EcoMENA,* March 28. http://www.ecomena.org/solid-waste-management-in-saudi arabia/. Accessed 24 March 2017.

———. 2015c. *Solid Waste Management in Kuwait*. *BioEnergy Consult*. July 13. https://www.bioenergyconsult.com/solid-waste-management-in kuwait/. Accessed 10 May 2017.

———. 2015d. *Solid Waste Management in Saudi Arabia.* March 28. http://www.ecomena.org/solid-waste-management-in-saudi-arabia/. Accessed 15 July 2017.

———. 2016a. Garbage Woes in Cairo. *EcoMENA*, November 2. http://www.ecomena.org/garbage-cairo/. Accessed Feb 2017.

———. 2016b. The Menace of Landfills in Kuwait. *EcoMENA*, January 2. http://www.ecomena.org/landfills-kuwait/. Accessed 28 May 2017.

———.2016c. Solid Waste Management in Oman. *EcoMENA,* April 3. http://www.ecomena.org/solid-waste-oman/. Accessed 8 May 2017.

———. 2016d. Solid Waste Management in Qatar. *EcoMENA,* October 5. http://www.ecomena.org/solid-waste-management-in-qatar/. Accessed 28 May 2017.

Zyoud, S.H., S.W. Al-Jabi, W.M. Sweileh, S. Al-Khalil, S.H. Zyoud, A.F. Sawalha, and R. Awang. 2015. The Arab world's Contribution to Solid Waste Literature: A Bibliometric Analysis. *Journal of Occupational Medicine and Toxicology* 10 (35), 1–9.

10

The Sustainability of Vicuña Conservation in Bolivia

Melissa Grigione, Lisa F. Daugherty, Rurik List, Jonathan Rushton, and Ronald Sarno

Background

The vicuña (*Vicugna vicugna*) once numbered in the millions and was the large, dominant, wild herbivore of the Alto Andina and Puna regions of South America. Between the late 1500s and 1960s, vicuñas declined to as few as 7000–12,000 animals as a result of competition with livestock and overhunting for their fine wool (Koford 1957; Franklin 1973; Rabinovich et al. 1991). Peru was the original pioneer of vicuña conservation, establishing the Pampa Galeras Vicuña Reserve in 1965 to protect and manage the surrounding populations on behalf of the local indigenous people. In the late 1960s and early 1970s, Argentina, Bolivia, Chile, and Peru signed an agreement for the conservation of the vicuña (Cajal et al. 1983), and in 1975 the vicuña was

M. Grigione (✉)
Department of Biology, Pace University, Pleasantville, NY, USA

L. F. Daugherty
Kleinfelder, Inc., Mount Dora, FL, USA

R. List
Area de Investigación en Biología de la Conservación, Departamento de Ciencias Ambientales, Universidad Autónoma Metropolitana, Lerma, Estado de Mexico, Mexico

J. Rushton
Institute of Infection and Global Health, University of Liverpool, Liverpool, UK

R. Sarno
Department of Biology, Hofstra University, Hempstead, NY, USA

R. Brinkmann, S. J. Garren (eds.), *The Palgrave Handbook of Sustainability*,
https://doi.org/10.1007/978-3-319-71389-2_10

also afforded international protection under CITES (Convention on International Trade of Endangered Species) guidelines (USFWS 1999).

At the present time, the vicuña is distributed from 9°30″ to 29° S latitude at altitudes of 3800–5000 m throughout the central Andean Mountains of Peru, Bolivia, Chile, and Argentina (Koford 1957; Franklin 1982; Wheeler 1995). These regions are characterized by harsh environmental conditions including low rainfall, high amounts of solar radiation, and low temperatures at night. These unproductive environments are unsuitable for intensive agricultural use.

Since the ratification of the CITES designation in 1979, overall vicuña population size has increased fourfold, with an annual growth rate of approximately 10.5 percent per year (Table 10.1). Estimates for 1965 and 1979 come from a study by Cardozo and Nogales (1979).

Because these early conservation efforts were successful, a debate ensued as to whether vicuñas could be utilized economically based on sound management and strong governmental oversight (Norton and Torres 1980; Eltringham and Jordan 1981; Rabinovich et al. 1991). The International Vicuña Consortium was formed to endorse the commercial trade of vicuña products in a manner that would provide long-term benefits to both the local indigenous people and vicuñas (USFWS 1999).

Production of vicuña fiber can only be achieved by the capture and shearing of wild animals.[1] Additionally, the shearing of wild vicuñas is labor intensive. Peruvian data indicate that efficient capture systems[2] require between 15 and 30 days of labor per kilo of harvested fiber (Lichenstein et al. 2002).

Table 10.1 Global population size of vicuñas

	Year						
Country	1965	1979	1996	2001	2003	2008	Source
Argentina	100	1070	32,283	33,414	50,100	72,678	Lichtenstein et al. 2008
Bolivia	1079	3384	33,844	56,383	60,000	62,869	DGB 2002; Lichtenstein et al. 2008
Chile	100	4087	19,848	16,899	16,899	16,942	Lichtenstein et al. 2008
Ecuador	0	0	522	1827	2058	2683	Lichtenstein et al. 2008
Peru	5000	55,500	66,559	118,678	149,500	188,327	Lichtenstein et al. 2008
Total	6279	64,041	153,056	227,201	278,557	347,243	

Due to abject poverty and unsuitability for crop production in the Apolobamba Reserve, the indigenous communities have developed a production system based on the sale of meat and fiber from domestic camelids such as the alpaca (*Lama pacos*) and llama (*Lama glama*). Although the market is primarily focused on domestic camelids, the vicuña is better adapted to the extreme environment as well as being a more efficient grazer upon the scarce vegetation compared with domestic camelids and other livestock.

In Bolivia, the supply of vicuña fiber is low, even though the international prices of high-quality natural fibers are high. Therefore, the vicuña offers a high-quality fiber that can reach a value of up to US$500/kilo on the international market, thus making it a target for poaching and illegal animal trade just like the highly prized shahtoosh from the Tibetan Antelope (*Pantholops hodgsonii*) (Schaller 1998). Although the illegal transactions associated with vicuña products have endangered the species, they, ironically, have also spurred the development of policies for vicuña protection, which has led to the development of sustainable conservation practices for the species.

Across the vicuña's range, Peru contains the majority of vicuñas, with 53 percent. Bolivia and Argentina have 21.5 and 18 percent of vicuñas, respectively, and Chile has approximately 5 percent. In the case of Bolivia, vicuñas are found in the La Paz, Oruro, Potosí, Cochabamba, and Tarija departments. Twenty one percent of the vicuña population in Bolivia is located within protected areas, where management and conservation efforts have been encouraged and supported by means of equipment and training (Direccion General de Biodiversidad 2002–2003). In addition, trained personnel participate in the capture and shearing of populations located within the nine conservation and management units (Table 10.2).

Table 10.2 Bolivian Vicuña population size by conservation area

Conservation area	1965	1981	1996	1999	2000	2001	2002	2003	Area (Km^2)
Apolobamba			6536	7522	8245	8299	8599	10,694	100,000
Mauri Desaguadero			7800	11,202	13,964	14,117	13,677	13,677	388,400
Patacamaya Malla			414	444	467	487	547	547	65,100
Mauri Sabaya			2308	3788	3934	7084	7015	7015	510,911
Desaguadero Poopo			2198	2535	2798	2126	3682	3682	447,300
Altamachi Morochata			790	790	790	790	790	790	23,300
Uyuni			3513	3597	3460	3460	3704	3704	483,200
Lipez Chichas			9057	14,192	18,297	18,297	18,297	18,297	1,282,445
Tupiza Sama			1279	1092	1723	1723	1594	1594	127,700
National Total	1097	4493	33,844	45,162	56,383	56,383	57,905	60,000	3,428,356

Source: Direccion General de Biodiversidad 2002–2003

The remaining 79 percent of vicuñas in Bolivia are geographically dispersed, whereby support of management and conservation activities are not concentrated and are limited to that provided by the Deputy Minister of Natural and Environmental Resources of Bolivia via the General Direction of Biodiversity (GDB)—the technical institution of the ministry.

Case Study

In 2003, we initiated a study of vicuña management within the Apolobamba Reserve of Bolivia, which is located on the border of Bolivia and Peru to the north of Lake Titicaca. The purpose of the study was to identify elements that would strengthen the relationship between sustainable management and conservation of vicuñas, while evaluating this relationship on the families and community system within the Apolobamba Reserve.

Socio-economic data were collected from five communities in the Apolobamba Reserve via participatory workshops and 12 semi-structured interviews with families from different socio-economic strata (see below). Secondary data were collected on: vicuña population size, the international markets for fine fibers and wools, and the capture, shearing, and marketing of vicuñas in both Bolivia and Peru. Changes in vicuña population size over time were analyzed in order to assess population growth rates and densities in different regions of the Altiplano.

Four workshops were carried out using the following tools to collect information:

(1) Timelines to investigate:

- Economic activities
- Climate and weather patterns
- Pasture management of domestic livestock species and conflicts with vicuñas
- Commercialization of livestock products
- Past and present projects and actions

(2) Participatory map to investigate:

- Pasture management for different species
- Vicuña movement and their contact with domestic livestock species

(3) An annual calendar showing the main economic activities in order to investigate:

- Labor demands by age and sex
- Input use
- Sale of products

(4) A matrix to determine main problems, potential solutions, actions, and institutions in the communities

Semi-structured interviews were carried out in the Apolobamba Reserve with key informants such as park guards, community leaders, and staff from local NGOs. Collected data include:

(5) Management systems for communal pasture areas in terms of:

- Rules for grazing domestic livestock species
- Rules for hunting and use of wild animals
- The classification of families within communities into three income groups (poor, medium, and rich), with an estimate of the number of families in each group
- The selection of one family from each socio-economic group (poor, medium, and rich) to carry out a semi-structured interview

In each community three semi-structured family interviews were carried out in order to collect quantitative and qualitative information on household size and household activities.

Additional information consisting primarily of governmental data and numerous published reports were collected from the following sources:

(6) Instituto Nacional de Estadísticas (INE)—Human population census in 1992 and 2001 (INE 2002a, b, c)
(7) International Union for Conservation of Nature (IUCN)—Red List of Threatened Species 2008 (Lichtenstein et al. 2008)
(8) *Ministerio de Desarrollo Humano* (Ministry of Human Development)—poverty statistics (Ministerio de Desarrollo Humano 1993)
(9) Proyecto de Desarrollo de Criadores de Camélidos del Altiplano Boliviano (Project for the Development of Camelid Breeders of the Bolivian Altiplano) (UNEPCA)—camelid population census in 1997 (UNEPCA 1999)
(10) *Ministerio de Desarrollo Sostenible y Medio Ambiente* (Ministry of Sustainable Development and Environment)—vicuña population census 1996

(11) Publications on the socio-economics of the study area (Schulte 1999; Villalba 2000)
(12) Publications on the marketing of agricultural and livestock products in the Bolivian Altiplano (Bernabé et al. 2003; Leon et al. 2000; Schumann 1992
(13) Reports and publications on vicuña population growth rates; the economic management of vicuñas, including capture, shearing, and culling; and the commercialization of vicuña fiber (ARMA 2003; Bonacic 2000; Gillson 2000; Hoces and Velarde 2004; Lichtenstein et al. 2002; Sahley 2000; Sahley et al. forthcoming)

We have summarized our methodology in Fig. 10.1.

Vicuña Populations, Fiber Harvesting, and Commercialization

In Peru, an average of 220 grams of fiber is harvested from each animal comprising a total of 13.25 kg/community/year. The yield for each of the ten Peruvian departments and the average for Peru is summarized in Table 10.3. In Bolivia, Apolobamba is the most productive region for vicuña

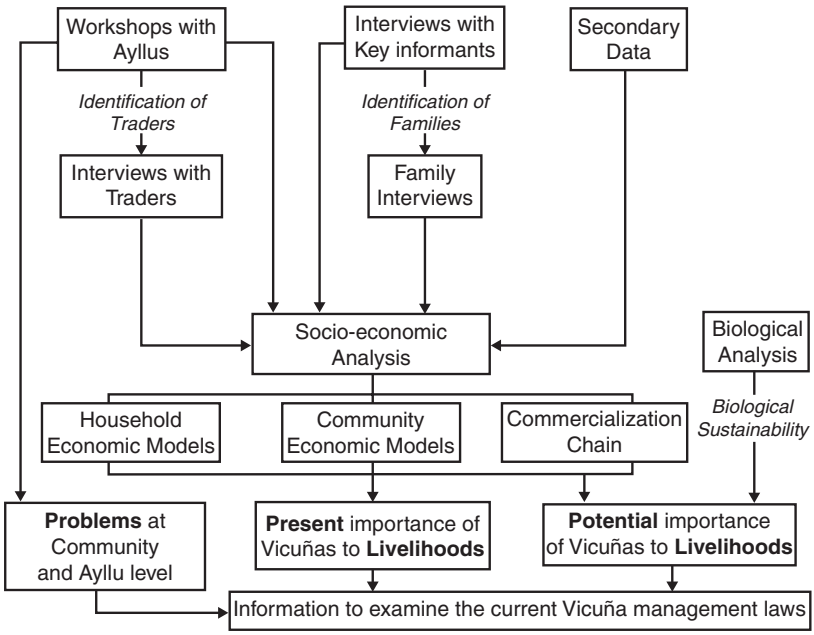


Fig. 10.1 Methodology for the collection of socio-economic data and analysis of the sustainable use of the vicuña in the Apolobamba Region of Bolivia

Table 10.3 Vicuña fiber production by communities within Peruvian departments

Department	Number of communities	Vicuñas		Fiber harvest (kg)			
		Captured	Shorn	Total	Per head		Per community per year
					Captured	Shorn	
Ayacucho	76	39,474	17,597	4028.660	0.10	0.23	13.25
Arequipa	8	682	350	69.350	0.10	0.20	2.17
Apurimac	22	2100	1573	245.280	0.12	0.16	2.79
Cajamarca	1	95	52	13.000	0.14	0.25	3.25
Cusco	8	298	202	41.185	0.14	0.20	1.29
Huancavelica	12	744	517	112.200	0.15	0.22	2.34
Ica	7	1018	657	125.800	0.12	0.19	4.49
Junin	15	3396	2442	466.540	0.14	0.19	7.78
Lima	24	2208	1552	362.278	0.16	0.23	3.77
Puno	106	10,118	5449	1076.940	0.11	0.20	2.54
Peru	**279**	**60,133**	**30,391**	**6541.233**	**0.11**	**0.22**	**5.86**

Data source: Personal communication CONACS

fiber harvesting. Between 1997 and 2003 more than half of the national accumulated fiber came from this region. Apolobamba is the highest contributor of vicuña fiber in Bolivia due to the number of animals captured and shorn, although the harvest per head in Apolobamba ranks third among the Bolivian Conservation Areas. In terms of fiber harvest per head, the Lipez-Chicas and Sajama Conservation Areas surpass that of Apolobamba (Tables 10.4 and 10.5).

Officially, in 2004, Sajama was the most important harvester of vicuña fiber in Bolivia with nearly 100 kilos of products. This area also had similar rates of harvest per head to Peru, indicating that the sustainable use of vicuñas in Bolivia can be as effective as that in Peru (the leading exporter of vicuña fiber). No official data were available for vicuña fiber harvesting in Apolobamba for 2004, but unofficial information indicates that 820 animals were shorn and 116 kilos of fiber were produced. This is equivalent to 141 grams of fiber per head (personal communication Rodolfo Nallar, Wildlife Conservation Society).

The amount of fiber harvested per head of vicuña is higher in the Bolivian sites, while the shearing rate per head is higher for the Peruvian communities. Based on the data in the above tables, the yield per head for Peru is approximately 80 grams greater than that for Bolivia. This difference may indicate that shearing practices in some Bolivia communities are less efficient than those in Peru.

Table 10.4 Vicuña accumulated fiber harvest between 1997 and 2003 in Bolivia

	Community organization			Vicuñas		Fiber harvested			
							Per head		
Conservation area	Regional	Communities	Families	Captured	Sheared	Total	Captured	Sheared	Per family
Apolobamba	Yes	25	1200	1723	1383	222.9	0.13	0.16	0.19
Mauri-Desaguadero	No		272	970	698	106.9	0.11	0.15	0.39
Lipez-Chichas	Yes	16	400	75	68	17.6	0.23	0.26	0.04
Sajama	Yes	13	300	111	76	17.8	0.16	0.23	0.06
National			**2172**	**2879**	**2225**	**365.2**	**0.13**	**0.16**	**0.17**

Data source: Direccion General de Biodiversidad 2004

Table 10.5 Vicuña fiber harvesting 2004 in different sites in Bolivia

	Vicuña			Fiber harvested				
					Per head			
Conservation area	Population	Captured	Sheared	Total	Population	Captured	Sheared	Per family
Mauri-Desaguadero	13,677	49	35	6.00	0.0004	0.12	0.17	0.02
Lipez-Chichas	18,297	150	135	25.84	0.0014	0.17	0.19	0.06
Sajama	3682	631	435	99.10	0.0269	0.16	0.23	0.33
Sur Carangas		333	209	33.00		0.10	0.16	
Azucarí		59	39	5.90		0.10	0.15	
National		**1222**	**853**	**169.84**		**0.14**	**0.20**	

Data on fiber production from Apolobamba was not available at the time the project was conducted. Data source: Direccion General de Biodiversidad 2004

Table 10.6 Biological and economic characteristics of the primary fine fibers in the world

Species	Fiber diameter (microns)	Fiber length	Wool Vellon (kilo)	Price US$/kilo		
				Highest	Lowest	Latest
Fine wool (sheep)	21	58		6	6	
Mohair (goat)	36 (25 kid)		2.6	24	28	
Cashmere (goat)	13–15	32 mm	0.3	90	17.5	65–80
Camel	20		2.3			
Alpaca	25.5	4 cm	1.6	2	28	12–28
Llama	28		1.5	0.5		
Vicuña	12–14	35 mm	0.2	600	270	270–320
Guanaco	14–16	35		400 (dehaired)	200 (not dehaired)	

While the authors realize that fiber from Chiru or Tibetan Antelope is finer than vicuña fiber, there are no data on the commercialization of this fiber (shahtoosh) because shearing live-caught animals is not possible and the commercial trade of shahtoosh is illegal

Vicuña Fiber Commercialization

When evaluating vicuña fiber commercialization, it is important to recognize that there is competition for sales from other fine fibers (Table 10.6). The per kilo price for vicuña fiber is much higher than cashmere, which is the closest substitute to vicuña. However, complications have been documented in association with the purchase and sale of vicuña fiber in Peru over the last few years (Lichtenstein et al. 2002), and current vicuña prices are likely to fall to a lower level in the future. At present, vicuña fiber accounts for less than 0.01 percent of the fine fibers market worldwide. The largest importers of fine fibers are Italy and Great Britain, which imported nearly 60 percent of imported fine fibers in 2001.

Description of Study Zone and Communities

In the municipality of Apolobamba (Pelechuco, Gral. Juan J. Perez and Curva) live 4585 families totaling 16,590 people (INE 2002a, b, c). Human population growth rate in these municipalities is low and it appears that the region is losing people through migration to larger cities. According to Wildlife Conservation Society (WCS) staff, Apolobamba has a population estimate of approximately 16,000 people; however, only 6000 (37.5 percent) members of the population are located in zones where vicuñas are present.

Table 10.7 Vicuña population growth rate and population density in the Apolobamba Reserve of Bolivia between 1996 and 2002

Year	Population	Annual growth rate (%)	Number of hectares per vicuña
1996	6536		15.3
1997	6593	0.9	15.2
1998	6442	−2.3	15.5
1999	7522	16.8	13.3
2000	8245	9.6	12.1
2001	8236	−0.1	12.1
2002	8556	3.9	11.7
Average	**7447**	**4.8**	**13.6**

Data source: Asociacion Regional de Manejadores de Vicuña Apolobamba 2003

Within Apolobamba, annual censuses of vicuñas indicate population decreases in some years, but the general trend is an annual population increase of nearly 5 percent (Table 10.7). This is much lower than the national rate of increase and also lower than the predicted increase between 1986 and 1996, suggesting that vicuña density in Apolobamba has reached a level where continued population growth is not likely.

The annual increase in vicuñas throughout their range has been approximately 10.5 percent per year, which is an indication of successful conservation efforts. In areas of higher vicuña population density, the annual population growth rate of vicuñas is much less than that in at lower densities (Bonacic 2000). Based on review of the case study in Pampa Galeras, Peru, the maximum grazing load in poor environments is 0.6/vicuñas/hectare/year, and 0.3/vicuñas/hectare/year in even poorer environments (Flores 1991, cited in Lichstenstein 2002). Hence, vicuña density in the most populated areas would likely already be at carrying capacity, particularly when we account for feeding competition with domestic llamas and alpacas.

Household Economics and Livelihoods in the Study Communities

Based on the analysis of economies within the study communities, the most important source of income appears to be mining (identified as "other"), which accounts for 29–68 percent of average family income. Earnings from livestock account for 31–65 percent of average family income. The most important species in terms of livestock numbers and contributions to net livestock income are the alpaca, llama, and sheep (*Ovis aries*), respectively, in all study communities. The most important product from the alpaca is fiber, followed by live animal sales. For llamas and sheep, the most important product is the sale of live animals. In terms of output per livestock unit, it appears that

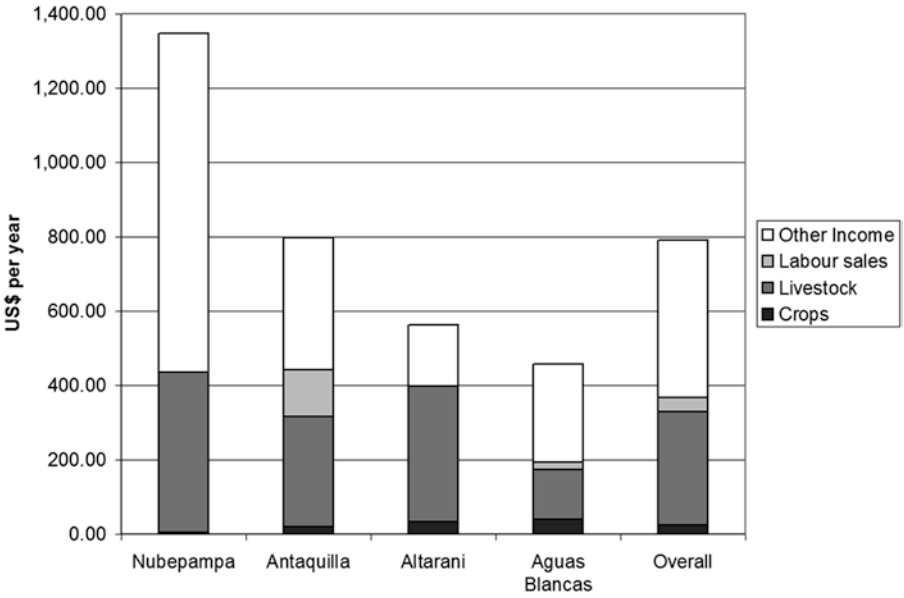


Fig. 10.2 The proportion of family income from crops, livestock, labor sales, and other sources

llamas perform the best across the region followed by the alpaca. Crop contributions to household income are negligible in all communities, while labor sales (providing services through the sale of labor) contribute to the average household income in three of the communities (Fig. 10.2).

Management and Conservation of Vicuñas in the Study Area

Two communal management areas (CMA) for the vicuña (Canton Antaquilla and Puyo Puyo) determine the means in which capture and shearing of vicuñas occur. There is variation between and within communities in the expectation of future income resulting from the sale of vicuña fiber and concern regarding the impact of vicuña population growth on the production of domestic livestock.

Organization for the Capture and Shearing of Vicuñas

Management of wild vicuñas involves the harvesting of fiber via the shearing of live animals that are captured temporarily on communal lands. This system of indigenous communities relies on strong organization of communal farming areas. In addition, according to case studies in Peru and Argentina regarding

Table 10.8 Average estimated value of production per head of vicuña captured and shorn for ten communities in Peru

	Average production value (US$)		
	Per head		
Department	Captured	Shorn	Per community per year
Ayacucho	32.45	72.80	4214.19
Arequipa	32.34	63.01	689.17
Apurimac	37.14	49.59	886.35
Cajamarca	43.52	79.50	1033.50
Cusco	43.95	64.84	409.28
Huancavelica	47.96	69.01	743.33
Ica	39.30	60.89	1428.73
Junin	43.69	60.75	2472.66
Lima	52.18	74.23	1200.05
Puno	33.85	62.85	807.71
Peru	**34.59**	**68.45**	**1863.90**

Data source: Personal communication CONACS

Weight of fiber produced multiplied by the price per kilo. The price is assumed to be an average price of US$318/kilo

management of vicuñas in semi-captivity and intensive breeding facilities, the use of wild-caught animals results in better economic benefits for the indigenous populations, therefore enhancing vicuña conservation.

The Regional Association of Vicuña Managers in Apolobamba (RAVAM) is comprised of various CMAs. In each CMA, there is a committee for vicuña management, which is responsible for coordinating, along with the RAVAM, the activities related to the management and conservation of the species. According to interviews, the RAVAM has very limited performance due to the lack of a formalized approach to fiber commercialization. Despite this, during the capture and shearing season, the Apolobamba Reserve and the RAVAM collectively organize the rotation of equipment (nets, ropes, medicines, etc.) and wildlife guard support at the communal level.

Data from Peru indicate that gross production per head of each captured and shorn vicuña is high, especially in relation to the low returns per head of domestic camelid production estimated for the Apolobamba Reserve (Table 10.8). The estimated returns per head of Peruvian vicuñas result in an average gross income of US$8.21/head and vary between US$5.95 and 9.54. The average daily estimates of labor costs for fiber harvesting is approximately US$8/day, but has varied from approximately US$5/day to almost $25/day from 1995 to 1999 (Fig. 10.3). Given the volatility of the markets and prices for vicuña fiber, it is important to assess the break-even prices for this commodity. The break-even price is calculated to be US$147/kilo. While this may appear low in comparison to the current price levels, it is still well above the price of cashmere—the closest substitute to vicuña fiber.

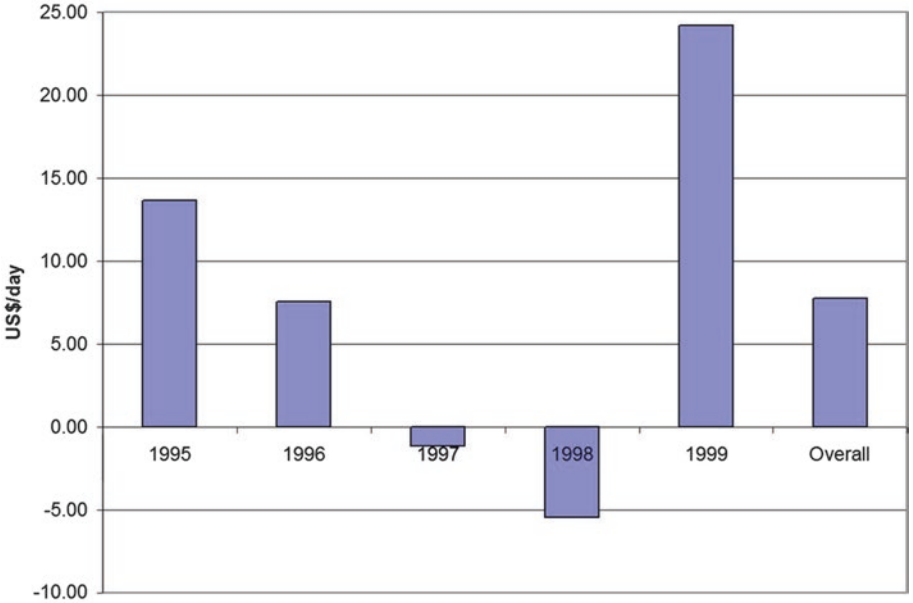


Fig. 10.3 Estimated returns per day labor for fiber harvesting in the community Tambo Cañahaus, Arequipa, Peru (Data source: Sahley et al. 2004)

Financial Analysis of Vicuña Fiber Commercialization

The value of vicuña fiber has been estimated using a price of US$385/kilo, which was the reported official price in 2004 in Peru. Using data for three capture and shearing locations in Apolobamba, the gross margin per person, per family, as well as per head of the vicuña population for each location was determined. Although total variable costs for the three regions are very similar, the gross margin differed significantly, with Huacanpata generating just over US$13.28 per head of vicuña, whereas Puyo Puyo was only US$1.21 (Table 10.9).

In Bolivia, a kilo of harvested fiber equates to approximately US$60–120 per kilo[3] in labor costs if people were paid at the time of capture. Accounting for fixed and administration costs, the overall break-even price for the area is US$157 with a range of US$108–340/kilo, across the shearing points, with an average of $158/kilo. The overall value is similar to that estimated for the Peruvian captures in Tambo Cañahaus, Arequipa, Peru (Table 10.10).

Based on the fixed costs associated with capture and shearing, in order to minimize the break-even price and maximize net income, sites need to share equipment and there needs to be a high level of coordination between communities.

Table 10.9 Fiber harvest of vicuñas, value of the harvest, and variable costs in three capture and shearing points in the Apolobamba Reserve, Bolivia

	Place of capture and shearing			
Items	Yanarico	Huacanpata	Puyo Puyo	Overall
Human Population	513	513	331	1357
Number of families	103	103	66	271
Vicuña population	440	508	4000	4948
Number of vicuñas captured	49	111	94	254
Number of vicuñas shorn	49	110	93	252
Number of vicuñas that died	0	0	10	10
Fiber harvested (kg)	6	19	14	39
Fiber per head of population	0.014	0.037	0.004	0.008
Gross value of fiber harvested (US$)	**2310**	**7315**	**5390**	**15,015**
Gross value per				
Person	4.50	14.26	16.28	11.06
Family	22.51	71.30	81.42	55.32
Head of vicuña population	5.25	14.40	1.35	3.03
Variable costs				
Eartags	551	551	551	1653
Rolls of plastics	86	87	87	260
Rolls of sack material	166	167	167	500
Veterinary medicines	136	137	137	410
Disposable needles and syringes	53	100	85	238
Application of medicines	30	30	30	90
Labor to separate fiber	1250	1250	1250	3750
Other labor	1875	1875	1875	5625
Transport	334	333	333	1000
Banderolas	38	38	38	114
Total Variable costs (Bs.)	**4519**	**4568**	**4553**	**13,640**
Total Variable costs (US$)	**565**	**571**	**569**	**1705**
Gross margin of the capture and shearing (US$)	**1745**	**6744**	**4821**	**13,310**
Gross margin (US$) per				
Person	3.40	13.15	14.56	9.81
Family	17.01	65.73	72.82	49.04
Head of vicuña population	3.97	13.28	1.21	2.69

In the analysis of cost-effectiveness, we anticipate that once fiber commercialization is started, the efficiency of management and organization of capture and shearing should improve. However, based on preliminary results, it is necessary to consider a management and harvesting strategy suitable for the characteristics and conditions of the country.

The vicuña has been positioned across different economic activities to see its importance in relation to other activities. The Ayllus, or productive communities of peasants, where vicuña populations are larger, have a negative perception of their presence, as long as there is no recognized economic benefit. People from

Table 10.10 Estimation of the fixed and administrative costs, net income, and break-even price for Vicuña fiber at three shearing points in the Apolobamba Reserve, Bolivia

	Place of capture and shearing			
Item	Yanarico	Huacanpata	Puyo Puyo	Overall
Fixed costs				
Training, organization	4050	4050	4050	12,150
Barretas	200	200	200	600
Clippers	82	82	82	246
Nets	19,416	19,416	19,416	58,248
Rope	17,600	17,600	17,600	52,800
Posts	1667	1667	1666	5000
Total fixed costs (Bs.)	**43,015**	**43,015**	**43,014**	**129,044**
Useful life (years)	10	10	10	10
Depreciation	3897	3897	3896	11,689
Interest @ 10%	3897	3897	3896	11,689
Annual fixed costs (Bs.)	**11,843**	**11,843**	**11,843**	**35,529**
Annual fixed costs (US$)	**1480**	**1480**	**1480**	**4441**
Net income (US$)	**265**	**5264**	**3341**	**8869**
Net income (US$) per				
Person	0.52	10.26	10.09	6.54
Family	2.58	51.30	50.46	32.68
Head of vicuña population	0.60	10.36	0.84	1.79
Break-even price (US$/kilo)	**340.88**	**107.97**	**146.39**	**157.59**

these groups feel that their economy, mostly based on alpaca ranching, which allows them to have access to products that are not in their system, will be affected by the presence of vicuñas. In the case of Puyo Puyo, which lacks agricultural lands but has extensive areas for grazing, and access to water that would be used by vicuñas, believe that vicuñas would negatively impact production of their livestock, thus promoting the migration of the human population.

All of the Ayllus share the expectations that when the harvesting of vicuñas begins they will receive economic benefits. Because of the information generated at fairs and events along the border with Peru, some people showed interest in implementing some type of management system like the system of semi-captivity in Bolivia, or outright domestication of the species, so they can have control over the populations. There is also misguided information that vicuñas can replace alpacas or llamas.

In summary, there is a diversified economy where income and other types of profits can be obtained, which allows the reproduction of a subsistence production system linked to the market through specific products such as alpaca fiber and occasionally gold. Also, the link to the market can be given by the change in consumption habits, where the strategy to get products is

through the generation of income from their production. If livestock ranching does not allow the communities to generate income, they have the strategy to generate income through activities such as: temporary jobs, migration to surrounding areas, mining, production of handcrafts, fishing, and finally seasonal migration to larger cities.

Lessons Learned

Experiences in Peru with regard to vicuña fiber marketing and from Bolivia with regard to general marketing issues suggest that a national monopoly has a number of critical disadvantages, which are principally the danger of capture of market benefits by a small, elite circle of people, and the need for government intervention if prices fall. It is also suggested that the distribution of benefits at the community level would be best carried out at a private or individual level, again to avoid the danger that the benefits would be captured by local elites. The most favorable scenario would be a change in the law in order to allow the national sale of vicuña fiber through a regulated market with individual and cooperative distribution of community benefits, which entails the payment of labor employed during the capture and shearing process.

The key conclusions from the study include:

(1) Vicuña populations are increasing across the region and in Bolivia, demonstrating the success of fiber harvesting as part of the conservation program, but creating pressures and conflicts with communities that are living in areas where vicuña population densities are becoming high.
(2) Current prices for vicuña fiber would appear high in comparison with other fine fibers in the world market.
(3) The fiber harvest per head of animals shorn and per head of population from Apolobamba are very low, perhaps due to a mixture of poor genetics, poor shearing management, and maybe some undeclared sales of fiber.
(4) The Apolobamba Reserve has an important livestock sector, but in particular alpaca production. This activity is the second most important in the livelihoods of the families interviewed, but the returns per animal are relatively low.
(5) The returns to vicuña fiber harvesting appear attractive and competitive in comparison with domestic livestock. However, these returns are dependent on the activity being well managed and vicuña fiber prices continuing to be high. The break-even price for this activity is around US$150,

which is considerably higher than the international price for cashmere, the closest alternative to vicuña fiber.

(6) Within the current changes in the Bolivian laws on vicuña management, we suggest that the commercialization of vicuña fiber should come under a nationally regulated market structure and that benefits from the harvest are distributed at the local level either individually or through cooperatives.

(7) Vicuña conservation management needs flexibility to include either compensation payments or controlled culls in areas with conflict between vicuña conservation and livelihoods.

(8) One of the most critical issues arising from the proposed model is the need to assess when people's livelihoods come into conflict with vicuña conservation. This requires simple parameters that need to include biological measures for when vicuña and domestic livestock-grazing competition reach a critical stage, parameters to assess and compare vicuña harvesting with domestic livestock production, and socio-economic parameters to determine how important livestock and vicuña incomes are to the livelihoods of different socio-economic groups.

(9) The production and socio-economic parameters could be developed as spreadsheet models, which could be tested in a future project.

More specifically, we have made several conclusions as to why the Apolobamba region—with such a high vicuña population density, has such low capture and shearing rates and low fiber harvest per animal in comparison to more aggressively managed areas of Bolivia and all the important vicuña fiber harvesting areas of Peru.

(10) The lack of benefits from vicuña management to date has had severe negative effects on the community and individual participation in vicuña capture and shearing.

(11) The lack of coordination between and within communities creates difficulties for the organization of the acquisition and distribution of potential benefits.

(12) The fact that there is no formalized, large-scale commercial harvesting of vicuñas in Bolivia results in the loss of interest of the communities in participating in the capture and shearing, and thus, poor results.

(13) There is undeclared fiber production that is sold in the Peruvian market. This would come principally from illegal hunting of vicuñas and impacts on the Bolivian market.

(14) The topography of the area makes vicuña capture difficult, which is believed to be an important factor that deserves further investigation

and the exchange of information from other communities with similar problems. Additionally, further investigation into modifying the community approaches to vicuña capture may be useful.

(15) The quality and quantity of pasture in the area could have a negative impact on fiber production, particularly as this area has such a high population density of vicuñas.

(16) The high proportion of animals shorn indicates that vicuñas are shorn regardless of age and whether they were shorn the previous year. The level of capture and shearing indicates that of the animals shorn, some are young animals.

(17) The timing of when vicuñas are shorn is not optimal. The recommended period is between September and October.

Challenges and Barriers

One particular concern is how benefits from the commercialization of vicuña fiber would be organized in order to generate the greatest level of income to people, families, and communities that live alongside vicuñas in the Apolobamba Reserve. The current organization in Peru in which a national monopoly buying position has been created appears to have run into difficulties. Hence, this would not be a sensible route for Bolivia (Lichenstein 2002). A regulated market would perhaps be a better alternative, but this requires careful thought on how and who would regulate the market. At the community level, benefits would best be distributed individually or through cooperatives. A fuller analysis of these aspects is presented below.

Although the sustainable management of the vicuña has been in place within specific regions of Bolivia for over 40 years, challenges exist to its large-scale success. The challenges range from those associated with the geography of the region, the tradeoff of one economy for another, defining who is responsible for sustainable management, lack of resources to implement sustainable practices, and maximizing the economic benefit realized by the communities who participate in sustainable management. Some of the challenges/barriers are summarized below:

(1) Continued vicuña population increases will entail greater competition between vicuñas and domestic livestock populations leading to conflicts even where vicuña fiber can be sold.

(2) Assessing the influence of vicuña genetics, grazing quality, and shearing management on the quality and quantity of fiber harvested from vicuñas.

(3) Economic returns per head of animal in domestic livestock systems that are grazing close to vicuña populations.
(4) Costs and benefits of alternative marketing systems for vicuña fiber.
(5) Local, national, and international responsibilities for vicuña conservation.
(6) Communities still do not perceive benefits obtained from the sustainable management of the vicuña despite an evident increase in the vicuña population.

Prices for vicuña fiber are unlikely to remain as high as they are at present for the following reasons:

(1) The change of Bolivian laws will create a substantial increase in supply in the short term. This may create a market crash.
(2) The constant vicuña population increases will also increase supply of vicuña products in the medium to long term.
(3) The current price probably contains a risk premium due to the previously illegal nature of marketing of vicuña fiber.
(4) The most similar fiber to vicuña fiber, cashmere, has a price that is approximately four times lower than that of vicuña fiber. The differences in quality appear relatively small but cashmere can be produced commercially rather than being harvested.

Notes

1. This view may be contested by recent Peruvian attempts to create enclosures with vicuñas. However, it is believed to be too early to assess the sustainability of such systems.
2. In inefficient captures, days of labor would be much higher.
3. Assumes a daily wage rate of US$4.

Further Reading

Hutton, J., and N. Leader-Williams. 2003. Sustainable U and Incentive-Driven Conservation: Realigning Human and Conservation Interests. *Oryx* 37 (2): 215–226. https://doi.org/10.1017/S0030605303000395.

McNeill, Desmond, and Gabriela Lichtenstein. 2003. Local Conflicts and International Compromises: The Sustainable Use of Vicuña in Argentina. *Journal of International Wildlife Law and Policy* 6 (3): 233–253.

Wheeler, Jane C., and Domingo Hoces. 1997. Community Participation, Sustainable Use, and Vicuña Conservation in Peru. *Mountain Research and Development* 17: 283–287.

References

ARMA (Asociacion Regional de Manejadores de Vicuña Apolobamba). 2003. *Plan de Manejo de Vicuña. Area Natural de Manejo Integrado Apolobamba*. La Paz, Bolivia: ARMA.

Bernabe, A., E. Felipe, G. Valencia, F. Martinez, and R. Arrazola. 2003. *Las ferias Campesinas. Una estrategia socioeconomica*. La Paz: Programa de Investigacion Estrategia en Bolivia (PIEB).

Bonacic, C. 2000. Dinamica poblacional de la vicuña (*Vicugna vicugna*) y determinación de la capacidad de carga en la provincia de Parinacota-Chile. In *Manejo Sustentable de la Vicuña y el Guanaco*, ed. B. Gonzalez, F. Bas, C. Tala, and A. Iriarte, 88–92. Santiago: Actas del Seminario Internacional Realizado en la Pontificia Universidad Catolica de Chile, SAG.

Cajal J.L., J. Pujalte, and A. Reca. 1983. *Resultados de los censos de camélidos silvestres en las reservas de San Guillermo (San Juan), aguna Brava (La Rioja) y Laguna Blanca (Catamarca)*. Report to the Xith Argentine Meeting of Ecology, Cordoba, Argentina.

Cardozo, A. J. Nogales. 1979. Evolucíon de las poblaciones de vicuña en Ulla Ulla (Bolivia). En: Reunión nacional de Ganadería, $a. Trinidad, Bolivia. ABOPA, La Paz, 11–30.

Consejo Nacional de Camelidos Sudamericanos (CONACS), Ministerio de Agricultura, personal communication.

Dirección General de Biodiversidad. 2002. *Plan de Manejo de la Vicuña en Bolivia*. La Paz: Ministerio de Desarrollo Sostenible y Planificación.

———. 2004. Plan de Manejo de la Vicuña en Bolivia. Ministerio de Desarrollo Sostenible y Planificación. La Paz, Bolivia, 55 pp.

Eltringham, S.K., and W.J. Jordan. 1981. The Vicuña of the Pampa Galeras National Reserve. The Conservation Issue. In *Problems in Management of Locally Abundant Wild Animals*, ed. P.A. Jewell and S. Holt, 277–289. New York: Academic Press.

Franklin, W.L. 1973. High, Wild World of the Vicuña. *National Geographic* 143: 76–91.

———. 1982. Biology, Ecology, and Relationship to Man of the South American Camelids. *Special Publication Pymatuning Laboratory of Ecology* 6: 457–489.

Gillson, L. 2000. Puede ser el uso de fauna silvestre sustenable? Contrastando los casos del antílope Tibetano y la vicuña. In *Manejo Sustentable de la Vicuña y el Guanaco*, ed. B. Gonzalez, F. Bas, C. Tala, and A. Iriarte, 265–271. Santiago: Actas del Seminario Internacional Realizado en la Pontificia Universidad Catolica de Chile, SAG.

Hoces, D., and R. Velarde. 2004. *Diagnóstico para la Comercialización de la Fibra de Vicuña en Apolobamba*. La Paz: Agencia Española de Cooperación and Servicio Nacional de Areas Protegidas.

INE. 2002a. *Censo Nacional de Poblacion y Vivienda 2001. Bolivia: Distribucion de la Poblacion*. La Paz: Instituto Nacional de Estadistica (INE).

———. 2002b. *Censo Nacional de Poblacion y Vivienda 2001. Bolivia: Mapa de Pobreza 2001*. La Paz: Instituto Nacional de Estadistica (INE).

———. 2002c. *Censo Nacional de Población y Vivienda 2001. La Paz: Resultados Departmentales*. La Paz: INE.

Koford, C.B. 1957. The Vicuña and the Puna. *Ecological Monographs* 27: 153–219.

Leon, G., V.H. Vasquez, and H. Valdez. 2000. *Mercado Kantuta: ¿Un mercado campesino?* La Paz: Programa de Investigacion Estrategia en Bolivia (PIEB).

Lichtenstein, G., F. Oribe, M. Grieg-Gran, and S. Mazzacchelli. 2002. *Poverty, Inequality and Environmental Series No 2*. London: IIED, Earthscan. Manejo Comunitario de Vicuñas en Perú. Estudio de caso del manejo comunitario de vida Silvestre.

Lichtenstein, G., R. Baldi, L. Villalba, D. Hoces, R. Baigún, and J. Laker. 2008. *Vicugna vicugna*. The IUCN Red List of Threatened Species 2008. https://doi.org/10.2305/IUCN.UK.2008.RLTS.T22956A9402796.en. Accessed 16 July 2017.

Ministerio de Desarrollo Humano. 1993. *Mapa de Pobreza. Una Guia para la Accion Social*. La Paz: UDAPSO, INE, UPP, UDAPE.

Nallar, Rodolfo. Wildlife Conservation Society, Personal Communication.

Norton M., and H. Torres. 1980. WWF/IUCN Unpublished Report. Gland, Switzerland.

Rabinovich, J.E., A.F. Capurro, and L.L. Pessina. 1991. Vicuña use and the bioeconomics of an Andean peasant community in Catamarca, Argentina. In *Neotropical Wildlife Use and Conservation*, ed. J.G. Robinson and K.H. Redford, 337–358. Chicago: University of Chicago Press.

Sahley, C.T. 2000. Poblaciones de Vicuñas en Vias de Recuperación: Un Análisis de Alternativas para su Manejo. In *Manejo Sustentable de la Vicuña y el Guanaco*, ed. B. Gonzalez, F. Bas, C. Tala, and A. Iriarte, 103–108. Santiago: Actas del Seminario Internacional Realizado en la Pontificia Universidad Catolica de Chile, SAG.

Sahley, C.T., J. Torres Vargas, and J. Sachez Valdivia. 2004. Community Ownership and Live Shearing of Vicuñas in Peru. Evaluating Management Strategies and Their Sustainability. In *People in Nature: Wildlife Conservation in South and Central America*, ed. K. Silvius, R. Bodmer, and J. Fragoso. New York: Columbia University Press.

Schaller, G.B. 1998. *Wildlife of the Tibetan Steppe*. Chicago: University of Chicago Press.

Schulte, M. 1999. *Llameros and caseros. La economia regional kallawaya*. La Paz: PIEB.

Schumann, D. 1992. *De Ovejas y Mercados. Lanas y textiles de Tajzara en Bolivia*. La Paz: ILDIS.

UNEPCA. 1999. *Censo Nacional Llamas y Alpacas Bolivia*. La Paz: Centro de Información para el Desarrollo – CID.

United States Fish & Wildlife Service. 1999. Endangered and Threatened Wildlife and Plants; Proposed Reclassification of Certain Vicuña Populations from Endangered to Threatened and a Proposed Special Rule. *Federal Register* 54: 47743–48757.

Villalba, L. 2000. Uso de habitat e interacciones entre la vicuña y alpaca en la Reserva Nacional de Fauna Ulla Ulla, La Paz, Bolivia. In *Manejo Sustentable de la Vicuña y el Guanaco*, ed. B. Gonzalez, F. Bas, C. Tala, and A. Iriarte, 67–84. Santiago: Actas del Seminario Internacional Realizado en la Pontificia Universidad Catolica de Chile, SAG.

Wheeler, J.C. 1995. Evolution and Present Situation of the South American Camelidae. *Biological Journal of the Linnaen Society* 54: 271–295.

11

The Efficacy of Small Closures: A Tale of Two Marine Protected Areas in Canada

Ryan Stanley, Corey Morris, Paul Snelgrove, Anna Metaxas, and Pierre Pepin

Background

Overview of Marine Protected Areas

Despite many efforts to improve ocean sustainability, ocean resources continue to decline globally as marine activities increase (FAO 2016). This decline has underscored a movement to develop and implement protection measures above and beyond catch quotas and gear limitations to meet sustainability targets. Marine Protected Areas (MPAs) are among the fastest growing tools to address conservation, sustainability, and marine management concerns (Claudet 2010). Here, we use the International Union for Conservation of

R. Stanley (✉)
Bedford Institute of Oceanography, Fisheries and Oceans Canada, Dartmouth, NS, Canada

C. Morris • P. Pepin
Northwest Atlantic Fisheries Centre, Fisheries and Oceans Canada, St. John's, NL, Canada

P. Snelgrove
Ocean Sciences and Biology Departments, Memorial University, St. John's, NL, Canada

A. Metaxas
Department of Oceanography, Dalhousie University, Halifax, NS, Canada

R. Brinkmann, S. J. Garren (eds.), *The Palgrave Handbook of Sustainability*,
https://doi.org/10.1007/978-3-319-71389-2_11

Nature (IUCN) definition for a protected area as "Any area of intertidal or subtidal terrain, together with its overlying water and associated flora and fauna, historical and cultural features, which has been reserved by law or other effective means to protect part or all of the enclosed environment". This definition is used by the Canadian Federal Marine Protected Areas Strategy (Canada 2005) and encompasses a wide range of types of spatial management approaches that do not necessarily prohibit all human activities that may result in disturbance of habitats or renewable resources.

Managers and scientists increasingly recognize that sustaining ocean health requires intact ecosystems and that management considerations must extend beyond fisheries stock assessment to include protection of ecological processes. This awareness has underscored the largest expansion in the number and spatial footprint of MPAs in history (Lubchenco and Grorud-Colvert 2015). However, even with this recent expansion, MPAs currently protect less than three percent of the global ocean (MPAtlas 2017) and even fewer of these could be considered or designed to offer full protection (Pendleton et al. 2017). The relatively small footprint of protected areas in the marine realm and the acknowledgment that MPAs are an important tool to mitigate biodiversity loss, has refocused attention on MPA establishment, leading to the designation of international targets for expanded MPA coverage. In particular, the Convention on Biological Diversity (CBD) adopted a revised strategic plan (2010) for the conservation of biodiversity including Aichi Target 11 to protect *at least ten percent* of coastal and marine waters by 2020, through ecologically representative and well-connected area-based conservation measures (CBD-UNEP 2010).

Anthropogenic activities increasingly threaten marine ecosystems, and no management system guarantees success in attaining specific conservation goals; however, MPAs offer a potential buffer to unknowns inherent in marine ecosystems (Christie and White 2007) and also provide umbrella protection to multiple species, including those not targeted by fisheries (Staub and Hatziolos 2004; Stewart et al. 2009). In particular, MPAs offer a pragmatic tool to complement traditional fisheries management, helping mitigate threats posed by ocean industry that can adversely affect biodiversity (Cook et al. 2013) and modify ecosystem structure and function (Garcia et al. 2012; Olsgard et al. 2008). Importantly, MPAs should not be applied or considered in isolation of traditional fisheries management practices (Hilborn et al. 2004). The multitude of threats facing the world ocean include global warming, ocean acidification, pollution, micro-plastics, invasive species, land-based runoff, and marine traffic and fishing, both legal and illegal (Hilborn 2017). Invariably, no one management or conservation tool will offer a panacea

to the multitude of threats and priorities facing marine systems. In short, marine protected areas, coupled with traditional management tools, can achieve a broad range of management objectives in marine systems. However, many factors influence MPA designation, including social, political, economic, and conservation considerations. As with many ocean use management measures, implementation, monitoring, and adaptive management of MPAs bring many challenges in attaining an acceptable balance between protection and access that ensures effective impact on sustainability.

Limits and Benefits of MPAs

The unique developmental history of many MPAs has resulted from various combinations of science, social, and political decision-making. Limited or lost access adds political pressure to constrain the size and number of MPAs, resulting in a wide range of MPA sizes, associated purposes, and efficacy (i.e., "paper" or "residual" parks; De Santo 2013; Devillers et al. 2015). MPA size ideally links to the biologically relevant scale of the threatened organism or ecosystem, but planning must also consider many socioeconomic factors. MPAs can provide a range of management and conservation benefits depending on the size and, importantly, the level of restriction (Lester and Halpern 2008). Small MPAs generally best address local and specific threats, analogous to fisheries closures, when working with existing management regulations, whereas much larger MPAs are generally created to address whole ecosystem processes and the protection of ecosystem services (e.g., Papahânaumokuâkea Marine National Monument; Toonen et al. 2011).

The relatively modest number and recent implementation of most MPAs limits our collective experience regarding their use and efficacy as a conservation tool, but the increasing traction of heuristic best practice guidelines for developing MPAs (e.g., Edgar et al. 2014) offers new promise. In this respect, the anticipated increased use of MPAs for biodiversity protection necessitates critical evaluation in order to recognize and potentially improve their contribution toward conservation objectives (Garcia-Charton et al. 2008; Pomeroy et al. 2005).

Ecological understanding of MPA effectiveness has not developed sufficiently to support detailed predictions with a high level of certainty (Halpern 2003, see also debate outlined in: Pendleton et al. 2017; Walters 2000). Case studies offer an opportunity to evaluate and understand MPA benefits in the context of a real-world application and design and may help identify key successes and limitations.

The Need for Clear Objectives, Demonstrable Benefits, and Plain Language

MPA monitoring provides a framework in which to evaluate MPA efficacy. MPAs can potentially help protect multiple species with diverse life histories which, in turn, may exhibit divergent responses to protection. In this sense, MPAs can potentially achieve a broad range of objectives for stakeholders with different perspectives and priorities for protection. MPA planners and advocates must work together to define conservation objectives for MPA networks and individual MPAs (IUCN 2004; Pomeroy et al. 2005). These objectives, first and foremost, must be clearly articulated, achievable, measurable, and contextualized (Claudet 2017). Unrealistic targets or expectations add unnecessary pressure on MPA managers, threaten continued support of the MPAs, and even influence future designations (Agardy et al. 2003; Pomeroy et al. 2005). Increasing demand for access to ocean resources will typically generate opposition to restrictions associated with MPA implementation, punctuating the importance of providing concrete evidence to justify the need for MPAs and to demonstrate net benefits both inside and outside their boundaries (Pascual et al. 2017).

MPA design must include a framework to measure potential changes in response to protection, positive or negative, in order to assess its value. MPAs established without specific objectives, such as to mitigate clearly defined threats, limit the capacity to target and detect specific problems or attribute any changes (whether positive or negative) to the MPA. Specifically, MPAs designed to mitigate loss associated with existing use (e.g., "residual reserves"; Devillers et al. 2015) might a priori limit the biological response to protection because the management intervention results in little real change in the system. Although some stakeholders recognize inherent value in an MPA irrespective of measured success, lack of evidence on clear benefits could open discussions regarding efficacy and avocation for removal and further contribute to the increasing inventory, and associated discourse, of MPAs that have failed to deliver positive societal or ecological outcomes (Gill et al. 2017; Lester et al. 2009). Scientific evidence forms the basis for most modern management plans and related decision-making, but the most effective plans use plain language that includes specific objectives to design MPAs that can be evaluated to provide management advice that can justify reduced access.

Measuring benefits requires identifying metrics to assess the value of management action(s). In general, people increasingly value the idea of protecting

areas for future enjoyment, thus providing societal support for the development of MPAs. Many stakeholders value MPAs through an economic lens, balancing industry with conservation objectives. The simplicity of placing a financial value on items that can eventually benefit local economies (increased biomass, recruitment, etc.) easily justifies management decisions based on that criterion. Intangible values, such as ensuring protection of large areas of ocean from present or future human impacts, are more difficult to evaluate and will likely lead to ambiguity in understating and quantifying any "value" associated with the conservation measure.

Increasing MPA size also increases the difficulty in measuring tangible benefits because sampling and enforcement logistics of large-scale (>100,000 km) areas greatly exceed those at small scales (i.e.< 1000 km), and the range of other potential uncontrollable drivers of change also increases with size. Nonetheless, conservation-oriented stakeholders place particularly high value on implementation of large MPAs (e.g. Garcia-Charton et al. 2008; Laurel and Bradbury 2006), despite the need for lengthy periods often required to attribute tangible benefits to protection, which are difficult in themselves to measure and maintain, particularly at a large scale (Claudet 2017).

MPA size and scale of monitoring should reflect MPA objectives or vice versa. Species-specific MPA objectives must consider the life history strategy of the protected species. For example, irrespective of size, detecting recruitment subsidy (larval dispersal and settlement) may be difficult, and in some cases impossible, particularly in differentiating a modest proportional change in recruitment from expected temporal and spatial variation in recruitment for most systems (~ 150–200 percent; Pelc et al. 2010). The ability to gauge unambiguously the efficacy of an MPA depends upon the intersection between MPA objectives and the spatial scale of a biological response (Agardy et al. 2003), and whether managers choose to utilize MPAs adaptively as one of their fishery (or other use) management devices. Like most management tools, MPA efficacy is as much a management responsibility as it is a biologically driven outcome. For example, when science advice is provided but ignored, the failure to achieve conservation objectives should come as no surprise, noting that failure in this instance arises from management failure rather than MPA efficacy. Ineffectively or inequitably managed MPAs may yield ecological responses up to three times less than those MPAs with adequate management action (Gill et al. 2017). Managers determine the value of a potential benefit, often considering many variables in addition to MPA-specific goals during a decision-making process.

Why Stakeholder Support Matters

The establishment of MPAs represents a societal choice, based on the view that oceans require additional protection that other management tools cannot provide. The ability to demonstrate MPA effectiveness, through appropriate design, monitoring, and evaluation, is part of a scientific process that supports other marine management decision-making and provides meaningful and measurable justification for MPA-related actions (Pomeroy et al. 2005). Most opposition to MPAs arises from marine stakeholders engaged in resource extraction who fear reduced access as a result of MPA creation and associated limits on activities. Often opponents to MPA establishment favor other, generally non-spatial, marine management approaches based on evaluation and comparing management effectiveness. Paradoxically, strong evidence of net benefits can itself lead to behavioral opposition, where benefits accrued (e.g., larger or more numerate resources) act as motivation for stakeholder exploitation (e.g., poaching; Bergseth et al. 2017). Support for both the application (benefits) and process (design and enforcement) is required to justify and maintain specific management actions. Gaining support for both application and process critically requires stakeholder participation in decision-making and monitoring (Epstein 2017). MPAs have garnered considerable support in recent years, based on a growing global observation that despite other marine management actions, ocean pressures continue to grow and overall health of the ocean continues to decline (FAO 2016). To justify continued support for MPAs, their "evaluation" (as "protection" in the name implies) must demonstrate value.

Canada has recently committed to increasing its number of MPAs and total marine area protected as a means to improve marine resource sustainability. This commitment promises to increase protected areas from < 2 percent of Canada's jurisdictional waters to 10 percent by 2020 (Government of Canada 2016). Although this level still falls well below the 20–30 percent recommended by major international conservation groups (Convention on Biological Diversity 2010; World Parks Congress 2014) or MPA experts (O'Leary et al. 2016), the strategy represents a major policy change from previous governments and an important step toward a more comprehensive sustainability strategy. The decision on whether to create MPAs has already been made based on a commitment to an international agreement, but now the focus is on trying to create effective MPAs that provide long-term benefits and meet conservation priorities.

Case Studies

As a case study, we compare two extant, small Canadian MPAs, Eastport Marine Protected Area (2.1 km^2) and Gilbert Bay Marine Protected Area (60 km^2), located in the Canadian province of Newfoundland and Labrador and established under Canada's Ocean Act in 2005 (Fig. 11.1). Design and planning for these MPAs started in 2000 when both areas were identified as "Areas of Interest" (AOIs), and thus candidates to become MPAs. During the decade since these MPAs were designated, their performance has been monitored as part of specific MPA management plans, providing important lessons to help guide future MPAs in Canada.

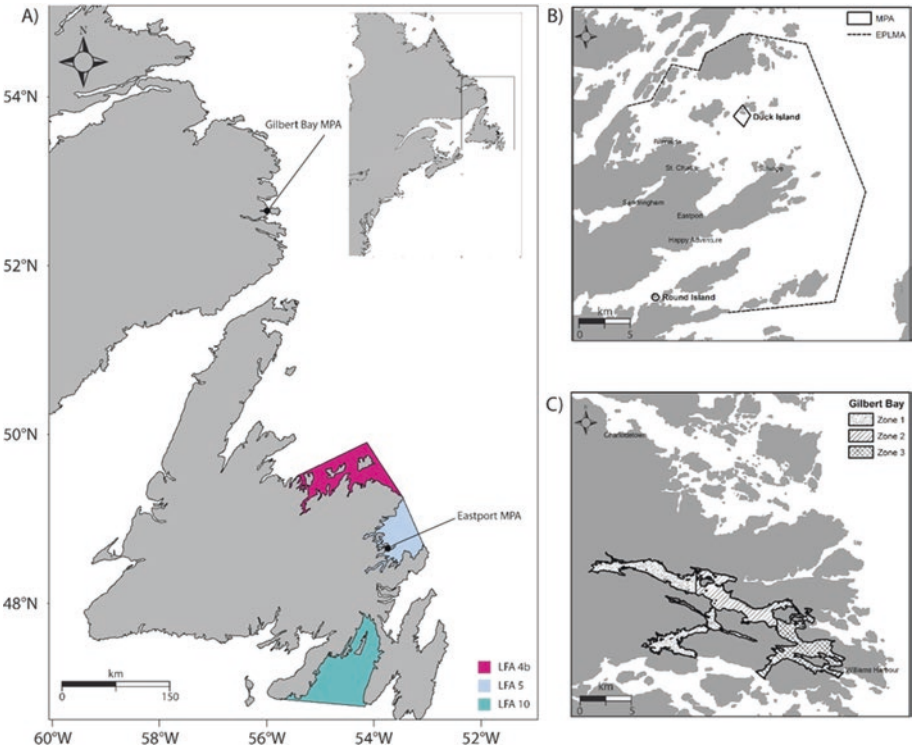


Fig. 11.1 Eastport and Gilbert Bay Marine Protected Areas (**a**) Map depicting the position of case study MPAs and lobster fishing areas used for evaluation of the Eastport MPA (Lewis et al. 2017); (**b**) map depicting the boundaries of the Eastport MPA closures and outer boundary of the Eastport Lobster Management Area; and (**c**) map depicting the boundary and zonation of the Gilbert Bay MPA. Inset in Panel (**a**) shows the location of the focal area in reference to the northwestern Atlantic coast

Case Study 1: Eastport MPA

History of MPA Development

The Eastport Peninsula is located on the northeast coast of Newfoundland, in Bonavista Bay. The economy of the peninsula historically relied heavily on marine resources and fisheries. With declines in groundfish in the early 1990s, and particularly in the once plentiful inshore stocks, the fishery shifted to non-traditional species, primarily American lobster (Collins and Lien 2002; Fig. 11.2). Increased participation in the lobster fishery led to increased landings until the mid 1990s when they began to fall dramatically.

The American lobster (*Homarus americanus*, hereafter lobster), a relatively long-lived, cold water shellfish species, inhabits the northwestern Atlantic

Fig. 11.2 Lobster traps set in the Eastport Peninsula. Lobster fishing has become a vital economic income since the decline in groundfish and subsequent fishing moratorium (Photo credit V. Howse)

from Cape Hatteras to Newfoundland (Cooper and Uzmann 1980). Lobster generally prefer shallow rocky complex habitat characterized by high macroalgal cover (Novaczek et al. 2017; Wahle and Steneck 1992). In Newfoundland, commercial lobster concentrations generally occupy this habitat type at depths less than 20 m (Rowe 2002). Lobster growth is temperature dependent, with individuals typically reaching sexual maturity between eight and 12 years; the colder waters of Newfoundland favor the latter. Indeed, in Newfoundland, lobsters could take up to an estimated 10 years before reaching the minimum size limit (82.5 mm) for the fishery and the presumed size at sexual maturity (~ 81 mm carapace length) (DFO 2013a). Despite significant recent progress in definitively aging lobsters (Kilada et al. 2012), the length of time to definitively reach sexual maturity remains unresolved.

As with adults, planktonic larval lobsters exhibit temperature-dependent growth and development, with pelagic residency time generally varying between three and eight weeks, again with longer periods for Newfoundland lobster than at warmer locations. Fecundity of females increases exponentially with size (Currie and Schneider 2011), with larger females presumably producing larger eggs with greater energy content (Attard and Hudon 1987) and larger, more active larvae (Stanley et al. 2016).

During the expanded lobster fishery, high exploitation rates approached 85 percent of total biomass, and catch often included both mature and immature individuals. Increased fishing effort and minimum legal size limits that provided little protection for immature individuals, resulted in egg production levels estimated at 1–2 percent that of the unfished population (FRCC 1995). These low levels of egg production led to warnings of heightened risk of recruitment overfishing by the Fisheries Resource Conservation Council (FRCC). To mitigate this risk, the FRCC recommended that harvesters and managers take actions to increase egg production (up to at least five percent of unfished levels), reduce exploitation rates, improve stock-size structure, and, where possible, reduce waste (FRCC 1995). In response to the FRCC report, local harvesters in the Eastport Peninsula formed the Eastport Lobster Protection Committee (EPLPC) which began to implement conservation initiatives in the 400 km^2 Eastport Lobster Management Area (EPLMA) (Charles and Wilson 2009), with a focus on protecting ovigerous and larger female lobsters. In 1997, in conjunction with Department of Fisheries and Oceans Canada (DFO), harvesters implemented two no-take closures in the EPLMA. These closures targeted known "hotspots" for ovigerous female lobsters with presumably highly suitable lobster habitat, protecting a combined footprint of ~ 2.1 km^2 non-contiguous locations surrounding two islands (Fig. 11.1b).

In 1999, the EPLPC began to formalize the fisheries closures within the EPLMA as an MPA under the newly proclaimed *Oceans Act*, with their official designation as an area of interest (AOI) the subsequent year. Stakeholders took an active role in subsequent years, identifying conservation priorities and delineating the MPA boundaries. Biophysical and socioeconomic overviews were also developed during this period, once again with strong stakeholder participation, providing the baseline information for AOI evaluation (Charles and Wilson 2009). In 2005, the Eastport AOI received official designation as an MPA.

Management interventions to further mitigate potential recruitment overfishing have continued since the FRCC report. In the EPLMA, harvesters initiated a voluntary V-notching program a year prior to the establishment of the fisheries closures. This program marked ovigerous female lobsters with a notch that would be retained for up to two subsequent molts, thus clearly identifying potential egg bearers and providing additional protection from capture. In 1998, DFO increased the minimum legal size for the province of Newfoundland from 80 to 82.5 mm, an action expected to support more lobsters reaching sexual maturity prior to capture. With high exploitation rates year over year, new recruits typically dominate catch composition (DFO 2013a) and legal size limits that better reflect the onset of maturity may therefore profoundly influence the productive capacity of the stock. Finally, in 2008, DFO reduced the harvester trap limit from 200 to 150 within the EPLMA (Lewis et al. 2017). These management interventions highlight the importance of the species to coastal Newfoundland and to the Eastport Peninsula in particular. More generally, the collective conservation efforts following the FRCC report demonstrate recognition by the industry of the potential benefits of conservation of egg production as a management tool.

Although Eastport is the only no-take closure designated as an MPA under the *Oceans Act* in Atlantic Canada, the concept of closures around productive areas is not unique to the Eastport Peninsula. In 2017, seven additional closures around the province of Newfoundland focused on American lobster, totaling 94 km^2. These closures were formally designated as "Other Effective Area Based Conservation Measures" (OEABCM), contributing toward Canada's Marine Conservation Targets objectives (ten percent by 2020) (DFO 2016, 2017b). Both the MPAs and OEABCMs limit the harvesting of ovigerous female lobsters in order to boost egg production. Noting the near linear relationship reported between individual production (fecundity) and lobster size, proponents hope these areas will also allow larger, more fecund, lobsters to survive and produce.

Conservation Objectives

The Eastport MPA has two primary conservation objectives:

1. To maintain a viable population of American lobster through the conservation, protection, and sustainable use of resources and habitats within the EPLMA.
2. To ensure the conservation and protection of threatened or endangered species.

The first conservation objective focuses specifically on American lobster, the species for which the MPA was designed. This objective considers the MPA's influence on the larger EPLMA (~ 400 km^2) lobster population. American lobsters are seen widely in the nearshore environment around coastal Newfoundland, and available genetic analyses indicate little population genetic structure (Benestan et al. 2015) in the region, suggesting significant larval exchange and connectivity among suitable lobster habitats. This MPA contrasts the Gilbert Bay MPA (case study 2), which focuses on an endemic and distinguishable population of Atlantic cod and thus was designed to encapsulate all known productivity and recruitment of the population. The lack of isolation of the EPLMA and MPA from adjacent areas significantly constrains assigning cause and effect of any changes to the local lobster population. For example, do declining local (EPLMA) catches over the past decade reflect the efficacy of the MPA? The small size (2.1 km^2) relative to the broader and interconnected EPLMA (400 km^2) and northeastern coast exacerbate the problem. Variability in local (EPLMA) lobster population demographics is more likely dependent on environmental conditions (success of larval recruitment), fishing pressure, and local non-spatial conservation efforts (e.g. increased minimum legal size, V-notching) extraneous to the protection afforded by the MPA. As a management intervention, the MPA alone likely contributes little to the viability of American lobster populations.

Although the MPA design and focus clearly prioritize the local lobster population, upon designation as an MPA, the DFO also incorporated the conservation of threatened species into the management plan (DFO 2013b) with specific reference to two endangered species, the northern and spotted wolfish (*Anarhichas denticulatus* and *A. minor*). This objective did not inform the design and placement of the MPA, and prior to the inclusion of this conservation objective, no evidence existed that either species inhabited the MPA. In reviewing the habitat characteristics of the MPA, Novaczek et al. (2017) suggest it is

"highly unlikely" that either species would inhabit its relatively shallow waters. Only Atlantic wolfish (*Anarhichas lupus*) are likely to inhabit waters as shallow as in the MPA, with < 10 percent (~0.21 km^2) of the MPA representing suitable habitat, although there have been no confirmed sightings of the species in the MPA to date (Novaczek et al. 2017). Because the Atlantic wolfish is not currently considered endangered, it would not fall under the conservation objective and is therefore not mentioned in the management plan (DFO 2013b).

Is It Working?

Several studies have gauged the efficacy of the Eastport fisheries closures (1997–2005) and the MPA (2005–onward), providing a time series to evaluate immediate and cumulative effects of protection. These analyses utilized monitoring data including yearly trapping and tagging surveys to derive population parameters including density, sex disaggregated size and movement rates, and proportions of ovigerous female lobsters both inside and immediately adjacent to the MPA. Initial analysis (1997–2000) revealed stable density increases inside relative to increasing or decreasing densities in outside areas (Rowe 2002). Although a greater proportion of ovigerous female lobsters (Round Island) and increased overall size of both sexes, were reported inside relative to outside the closures, the observed differeces were not statistically significant. Tagging studies revealed small scales of movement, with most individuals (77 percent) moving less than 1 km from the release point and few (< 10 percent) transiting the MPA boundary (Rowe 2001). These initial observations suggested that the scale of the closures could support the objectives of increased egg production and refugia for larger lobsters. A follow-up study (1997–2007) confirmed this supposition, showing little movement outside the MPA (<5 percent) and a larger, more complete size structure within the closures a decade after protection (Janes 2009).

The generally positive evaluations of the Eastport spatial closures were made with reference to nearby comparison sites within the EPLMA. In these cases, the difference between protected and unprotected areas, and trends through time determined efficacy. In most cases, evaluating efficacy using areas so close in proximity would be problematic, because the MPA itself could influence adjacent areas through larval spillover, acknowledging limited adult movement in the region (Janes 2009; Rowe 2001). As previously stated, lobster populations within the MPA and the EPLMA likely connect to lobster populations outside the management area. This relatively unresolved connectivity creates unambiguity in attributing MPA or EPLMA population vital

rates (e.g., changes in density, size, or productivity) to the management action. Lewis et al. (2017) therefore conducted an in-depth synthesis of available monitoring data for the region (1997–2013) including landings, catch per unit effort (CPUE), logbook data, and tag returns (Fig. 11.3). The study developed indicators of change in abundance, proportion of ovigerous female lobsters, and size structure for the MPA, EPLMA, and lobster fishing area (LFAs) including the local and adjacent assessment units (LFAs 5 and 4b, respectively). Comparisons also included LFA 10, an assessment area likely unconnected to Eastport but with similar environmental characteristics and exploitation history (Fig. 11.1). From this comparison, Lewis et al. (2017) confirmed positive and stable population attributes reported in previous analyses (Janes 2009; Rowe 2002) but also demonstrated that the observed changes were mostly indistinguishable from regional-scale patterns.

Given the minimal additional biomass for a measurable effect through adult migration (Lewis et al. 2017) owing to the relatively small size of the MPA, larval spillover offers the most likely mechanism to contribute to the EPLMA lobster population. The higher average density and larger size of lobsters within the MPA compared to surrounding areas presumably enhances reproductive potential for the area. The most recent information (2009–2013, Lewis et al. 2017) suggests a higher population density within the MPA than outside (~ 26 ± 5.7 vs. 18 ± 0.26 lobsters•ha^{-1} ; ± sd). This surplus density translates into ~1700 additional lobsters added through protection, corresponding to less

Fig. 11.3 Large female lobster tagged as part of the monitoring program in the Eastport MPA (Photo credit V. Howse)

than half a percent of the estimated total number of lobsters within the EPLMA based on areal expansion. However, the Eastport closed areas likely realize even smaller surplus production. Recent habitat assessments find that only 48 percent (~1 km^2) of the MPA represents appropriate "lobster habitat" (Novaczek et al. 2017), suggesting surplus production of even fewer than 815 lobsters. Moreover, monitoring data from MPA inception suggests the protected areas held higher densities of lobster historically (Lewis et al. 2017), reducing the likelihood that any surplus can be attributed to the management intervention alone.

Larval lobsters released from the Eastport MPAs experience among the coldest pelagic environments in the species' range (Aiken and Waddy 1986), increasing pelagic duration, and cumulative mortality compared to southern, warmer populations. Extended dispersal and heightened mortality will dilute any signal from surplus larval production (likely < 815 surplus lobsters), thus decreasing the probability of detection. Past attempts to model larval dispersal-connectivity relationships have examined much larger spatial scales than the EPLMA (e.g., Chasse and Miller 2010, Incze et al. 2010) and even those cases yielded highly variable results and were difficult to validate with settlement and/or landings data. Moreover, dispersal exceeding only 20 km, especially from the Duck Islands component of the MPA (Fig. 11.1), would transport larvae well beyond the EPLMA. Even larvae entrained in the local assessment area (*sensu* Gilbert Bay cod larvae) from any resulting surplus production would require up to 8–12 years of development with associated mortality, further diluting any definitive recruitment signal.

The FRCC report emphasized conservation of egg production as a tool to mitigate declining lobster landings in Atlantic Canada (FRCC 1995). By providing a refuge for higher densities of larger lobsters, the Eastport MPA undoubtedly boosts egg production, albeit at a relatively small scale in terms of surplus biomass and spatial footprint. Coinciding with the establishment of the fisheries closures in the EPLMA, implementation of both V-notching and increased minimum legal size has occurred in combination with a general reduction in fisheries participation (number of traps and fishermen). Arguably, these extraneous non-spatial egg conservation measures and declining participation likely contribute significantly more to the conservation objective than the MPA itself, further confounding evaluation of MPA efficacy.

Although ongoing monitoring undoubtedly provides key information about population demographics and MPA performance (Lewis et al. 2017), coincident changes to egg conservation measures within the fishery, coupled with the difficulty of assigning connectivity at this small spatial scale, limit efforts to monitor and evaluate the primary conservation objective to

maintain a viable population of American lobster in the EPLMA. If the Eastport MPA success hinges upon a measurable biological effect at the scale of the EPLMA, Eastport might pose an illusion of benefit (e.g. increased density and prevalence of large lobsters) where no measurable influence actually exists (Agardy et al. 2011).

The second conservation objective for the MPA was to "*ensure the conservation and protection of threatened or endangered species*" with particular focus on the threatened wolfish. Given the absence of any observation of either endangered wolfish species in the MPA, and lack of any suitable habitat, providing an unbiased and substantive assessment of this objective appears highly unlikely.

Pros and Cons of the Eastport MPA

The Eastport MPA process prioritized community engagement, and in many respects the EPLPC and local stakeholders drove the genesis, design, and continued success of the MPA (Davis et al. 2006). In particular, DFO developed and conducted the MPA monitoring program in close collaboration with local fishermen using commercial at-sea sampling, commercial logbooks, and chartered out-of-season fall sampling. This community involvement not only catalyzed MPA development but has also generated significant fisheries-related research (e.g. Burdett-Coutts 2011; Collins and Lien 2002; Janes 2009; Lewis et al. 2017; Novaczek et al. 2017; Rowe 2001, 2002) in which local fishermen worked with scientists from Memorial University of Newfoundland, DFO, Parks Canada, and local high schools. The stewardship initiative undertaken by the Eastport community with the formation of the EPLPC, and the creation of voluntary and conservation-focused closures in response to the FRCC report (FRCC 1995), exemplifies how stakeholder participation can lead to active co-management of a resource.

Since their inception, the Eastport spatial closures have shown some clear positive demographic benefits, befitting what many expect of an MPA (e.g., Lester et al. 2009). These benefits include increased densities of lobsters within the MPA and broadening of size structure to include larger, presumably more fecund lobsters. Although mostly subtle and difficult to disentangle from pre-existing differences and larger-scale trends (Lewis et al. 2017), these MPA benefits nonetheless provide some, albeit limited, improvement in the focal species. The MPA should be regarded as it was originally intended by the EPLMC, as one tool in a variety of approaches undertaken by stakeholders and the regulatory body to conserve egg production. The Eastport co-management approach

provides a template for the participatory processes required for the successful implementation of MPAs as a conservation tool (sensu Epstein 2017).

The Eastport MPA offers many lessons. First and foremost, the expectations of the management intervention must match the design. The small size of the Eastport MPA limits its ability to meet its primary conservation objective, and its design (placement) precludes it from meeting its secondary conservation objective for threatened and endangered species. These shortcomings do not necessarily indicate a failure of the MPA as it is applied (2.1 km^2 of shallow rocky habitat) but rather a failure of the expectations by which success is gauged. The MPA was initially designed as a fisheries closure focused on American lobster and as one of several tools to conserve egg production. In this light, the closure offers a potential success story rather than a cautionary example when developing conservation objectives.

Many tools can support egg conservation and, as FRCC and many others documented, ignoring egg production creates high risk of recruitment overfishing. Typically, industry recognizes the utility of spatial closures as a tool for egg conservation (Ennis 2011) and currently DFO has set aside approximately 100 km^2 within nine non-take lobster closures in Newfoundland, including the Eastport MPA. If designed and gauged effectively, small no-take closures could provide an important conservation tool for American lobster in Newfoundland. The application of this conservation approach to southern lobster populations will require a similar baseline analysis, paying particular attention to the scale of the MPA relative to local lobster movement scales (e.g., Janes 2009; Rowe 2001). Movement scales observed in habitats characterized by warmer waters and significantly less spatial complexity (e.g., den Heyer et al. 2009) suggest that small spatial closures targeted for lobster would likely achieve limited success in other regions.

Case Study 2: Gilbert Bay Golden Cod MPA

History of MPA Development

A distinct population of locally adapted Atlantic cod, known locally as "golden cod", resides in Gilbert Bay, Labrador (Fig. 11.4). Unlike other northern cod, the Gilbert Bay population thrived during the 1990s (Morris et al. 2014), at a time of extremely high natural mortality (DFO stock assessment 2016) following closure of the commercial fishery in 1992. During a small "test" fishery (1998–1999), abundances of Gilbert Bay cod were found to be high relative to historic levels, countering trends in

Fig. 11.4 Gilbert Bay "golden cod" with characteristic golden brown coloration (Photo credit C. Morris)

other populations of northern cod. Recognizing the threat posed by commercial fishing, residents of local communities initiated efforts to protect the Gibert Bay population. With support from the Department of Fisheries and Oceans Canada, interim fisheries protection measures through AOI designation were established in 2000, followed by formal MPA designation in 2005.

The MPA continues to protect spawning and overwintering areas for golden cod (Janes et al. 2009; Morris and Green 2010). However, the ongoing long-term monitoring program for Gilbert Bay demonstrates that some large migratory individuals move outside the MPA during periods of summer feeding (Morris et al. 2014). A limited sentinel fishery that targets northern cod near the boundaries of the MPA catches these large, migratory cod (Morris and Green 2014), which represent an important component of the population. Compared to smaller and younger cod, the large individuals produce more eggs, have acquired critical experience needed for successful migration (Morris et al. 2014), and prey upon other fish species that exert predation pressure on juvenile Gilbert Bay cod (Morris and Green *unpublished data*). Continued fishing threatens abundances of large migratory Gilbert Bay cod that stray outside MPA boundaries, potentially limiting the capacity of the population to rebuild to historical levels.

Gilbert Bay encompasses a long, fjord-like narrow inlet with shallow sills and an island archipelago at the headlands that restrict population connectivity to the adjacent Labrador Sea. The 60 km^2 MPA protects most life history stages for the local cod population, providing spawning habitat and critical juvenile nurseries. Local physical features and hydrographic conditions, such

as reduced salinity at the surface, restrict dispersal of early life stages. Adult Gilbert Bay cod remain primarily within the MPA boundaries; however, some individuals move short distances outside the MPA during summer to forage on capelin and other fishes.

Atlantic cod (*Gadus morhua*) can occur in extremely high levels of abundance and have been prized commercially for many centuries; not surprisingly, they are among the best-studied groundfish species in the world (FAO 2012; Kurlansky 1998). Throughout the range of Atlantic cod, geographic features such as continental shelves, continental slopes, specific coastal areas and bays, and semi-enclosed fjords help define heterotypic groups of fish (i.e., populations, sub-populations, and races; Robichaud and Rose 2004; Skjaeraasen et al. 2011), that often differ genetically (Bradbury et al. 2011; Knutsen et al. 2007) and behaviorally (Morris et al. 2014; Salvanes et al. 2004). Gilbert Bay cod are uniquely adapted to local environmental conditions (Morris et al. 2014), and such genetic diversity in a population may enable some populations to persist during periods of changing environmental conditions.

Conservation Objective

The Gilbert Bay MPA focuses on a local endemic population of Atlantic cod, and the scale of the MPA was designed to encapsulate most of this population, based on movement scales across all life history stages (DFO 2010; Morris and Green 2002, 2014; Morris et al. 2014). Abundance of Atlantic cod in the Western Atlantic remains low, and several populations are considered threatened (COSEWIC 2010); a limited commercial fishery for cod nonetheless continues. The abundance of Gilbert Bay cod today is at its lowest level since MPA monitoring began. Arguably, the MPA has not fully achieved its conservation objective of *the conservation and protection of the Gilbert Bay cod and its habitats*; however, without MPA protection, the population would have likely declined much faster. At a minimum, this protection provides management with a tool to ensure commercial activity does not moderate any potential population rebuilding. Furthermore, recognition of the biological value of this population continues to grow (Fig. 11.5). Research has demonstrated the genetically and behaviorally distinct nature of golden cod relative to other Atlantic cod populations and noted its persistence through a period of extremely high natural mortality associated with cold temperatures observed in most other Atlantic cod populations. Management objectives must include maintenance of intraspecific

Fig. 11.5 The Gilbert Bay cod sampling program samples, examines, and releases cod, in efforts to track population trends. The Gilbert Bay MPA monitoring program has been conducted continuously for 20 years and is among the longest MPA monitoring time series for an Oceans Act MPA in Canada. The monitoring program has tracked the population very well with clear results and has provided clear management advice against a specific conservation objective (Photo credit: D. Howells)

biodiversity, because this diversity will underline species' plasticity (i.e., survival) in response to variable environmental conditions. The scope of this plasticity will be particularly important for attaining conservation objectives despite dynamic environmental conditions, including global climate change. Indeed, numerous studies highlight how the loss of fine-scale population structure risks serial depletion of unique sub-components, thereby lowering stock productivity (Frank and Brickman 2000; Smedbol and Stephenson 2001) and potentially resulting in permanent losses of local adaptation, species persistence, and overall resilience to change (Dean et al. 2014; Roberts et al. 2017; Schindler et al. 2010).

Although the consequences of continued population decline in Gilbert Bay are difficult to predict, examples of extirpation and subsequent lack of recovery in other local cod populations (e.g., Dean et al. 2014; Robichaud and Rose 2001; Skjaeraasen et al. 2011) highlight that the recovery of the population and its genetic diversity is not guaranteed. To fully achieve the conservation objectives of the Gilbert Bay MPA boundary modifications (as initially proposed in 2012; Morris and Green 2014) or a targeted strategy to minimize fishing mortality (e.g., cod potting or live release of golden cod from commercial fishing) when golden cod mix with other northern cod

stocks outside these boundaries, will be required. Given the lack of support for changes in MPA boundaries among some stakeholders, the latter strategy will likely prove more tractable. Options include adaptive fishing strategies such as the live release of "golden cod" or seasonal restrictions near the MPA when migratory cod are most likely to traverse MPA boundaries (Morris et al. 2014).

Is It Working?

Scientific research and commercial fishing data demonstrate that some Gilbert Bay cod move short distances (<20–30 km) beyond MPA boundaries in summer. After MPA designation, acoustic tagging revealed locations and timing of movement of Gilbert Bay cod beyond the MPA boundary (Morris et al. 2014). Mortality associated with commercial fishing in those areas contributed to the declining abundance of Gilbert Bay cod (Morris et al. 2014). This observation highlighted how well-intended protection efforts may not succeed when the spatial scale of the MPA mismatches movement characteristics of the focal species and/or population.

The spatial scale of the Gilbert Bay MPA (60 km^2) was determined early in the establishment process based on the expected spatial scale of the local cod population. This decision built on preliminary scientific evidence, local knowledge, and acceptable interaction with other fisheries. At the time when boundaries were determined, small individuals dominated the population; these small individuals were not as susceptible as larger cod to gillnets used in commercial fishing. Further, cod less than 35 cm generally remain relatively sedentary and were not likely to move outside the MPA. As the population demographic changed, between 1998 and 2007, many individuals reached migratory sizes and grew to a size selected by gillnets. This likely changed the rate of removal of the Gilbert Bay cod. Since 2008, relatively few large migratory cod have been sampled during annual monitoring (DFO 2017a; Morris and Green *in prep*). Despite the removal problem, the Gilbert Bay MPA protects important spawning and overwintering areas for golden cod, likely reducing the rate of population depletion. Scientific research that identified these important areas helped to define a zoning plan with regulations associated with specific life history stages (Fig. 11.1c). Zone 1 is an important overwintering and nursery area; Zone 2 is a migratory pathway; and Zone 3 is a summer feeding area. Increased abundance of northern cod could alleviate pressure on Gilbert Bay cod under current management measures; however, any changes to northern cod management as the stock grows, such as extended fishing season and larger quota, could affect the Gilbert Bay cod population.

Stakeholders and managers have received ongoing advice on adaptive management since 2007 (Morris and Green 2014). However, stakeholders from both local communities and government have been reluctant to implement any official change in MPA boundaries because these boundaries were established through extensive consultation. Moreover, changing regulations is both complex and time-consuming. Efforts continue to adapt fishing seasons and fishing methods and to integrate MPA management with other fisheries management measures to sustain the Gilbert Bay golden cod population.

Pros and Cons of Gilbert Bay MPA

The Gilbert Bay MPA design protects key stages of the endemic population's life history, encompassing about 90 percent of its entire range and thus habitat. The MPA represents one of the few definitive examples of a protected area that encompasses such a complete range of egg, larval, juvenile, and adult life history stages. The monitoring program for Gilbert Bay has been ongoing since 1997, providing scientific information as part of adaptive management. This program has been a particular strength of the MPA, enabling continuous scientific assessment of its efficacy. Monitoring indicates decreasing abundance of Gilbert Bay cod and research attributes this decline to mortality outside the MPA boundaries (Morris et al. 2014). Unfortunately, changes to fishing activity were implemented three years after their recommendation (2008–2010), despite the unprecedented certainty of the basis of this decline. Furthermore, management efforts to shift fishing locations or season were met with controversy and diminished much needed local support for MPA conservation efforts. Additional efforts are also under way, such as live trapping (e.g. cod pots) and the development of rapid genetic identification tools (Sinclair-Waters 2017), to facilitate live release of golden cod captured by harvesters.

Lessons Learned

Small Size Can Work for Some Objectives, Not Others

MPA size is an important design element that must be scaled to MPA objectives and the desired conservation outcome. MPAs can produce positive, demonstrable benefits and MPA size itself is not a strong predictor of biological response relative to protected areas ("response ratio"; Halpern 2003; Lester et al. 2009; Micheli et al. 2004). Importantly, though larger MPAs produce

larger per capita effects and are most certainly preferred (e.g., Laurel and Bradbury 2006; Walters 2000), these analyses suggest that small MPAs can still lead to positive outcomes. Well-designed and managed small MPAs can achieve measurable targets with a modest budget. MPA designs based on scientific advice usually include scientific monitoring plans and specific, quantifiable indicators. They also recognize and protect against specific threats. However, mismatches between the conservation objective and MPA size (e.g., Abecasis et al. 2014) can result in situations where the MPA cannot produce measurable benefits, even if such benefits accrue. The Eastport MPA's small size, for example, will likely preclude any detectable spillover benefits for fisheries because the scale of larval movement greatly exceeds MPA boundaries, and any signal of surplus biomass (more and/or larger lobsters) emigrating from the MPA would be highly localized and small relative to the natural variability in the system. Nonetheless, the Eastport MPA has helped to promote a strong conservation ethic with significant support from the fishing industry and local community, yielding other benefits that help management efforts (e.g., more careful handling, release of immature females, V-notching).

MPA conservation objectives and associated monitoring should explicitly consider the magnitude and spatial scale of the biological response. Large mismatches in MPA size relative to species range or ecological need, or MPAs that offer little change from the status quo (e.g., very small MPAs), will likely result in diffuse change, if any (Agardy et al. 2003).

Need for Adaptive Management

The inability to implement adaptive management creates a major roadblock that limits the potential effectiveness of an MPA. In the case of Gilbert Bay, harvesters would not accept change in boundaries identified and established based on lengthy consultation (five years). Changing boundaries would also require considerable regulatory effort, reducing the appeal for both resource users and regulators alike. The Gilbert Bay experience illustrates the need to incorporate an adaptive management plan with MPAs during the consultative process prior to designation.

The Eastport case study illustrates the need for appropriate MPA size and design criteria, including the designation of appropriate monitoring locations that can be used both to demonstrate fishery improvement and attribute improvements specifically to the management intervention. Stakeholders expect that MPAs with specific objectives to improve fishery yields (e.g., spillover) will produce measurable results and reduce support when monitoring

cannot measurably demonstrate that specific goals have been met. Although in some instances the MPA may not achieve the goal of measurable spillover, other positive results such as increased biomass, larger fish size, or enhanced species diversity may emerge (e.g., Goni et al. 2010). This unintended consequence could represent a positive outcome, particularly if these benefits were listed among the conservation objectives.

Monitoring programs that inform management should be based on scientific advice provided as quantifiable indicators of a defined objective(s). Like the design of the MPA, the plasticity of conservation objectives should be a key consideration for adaptive management. For example, the secondary conservation objective of the Eastport MPA focuses on the protection of endangered or threatened species, with particular focus on wolfish. This objective was developed in the absence of any information of these species residing within, or even near, the MPA (Novaczek et al. 2017), decoupling contextual information provided by monitoring (e.g., lack of wolfish) from the management intervention. Many examples demonstrate species redistribution in response to stress, and to climate change in particular (e.g., Perry et al. 2005), thus potentially requiring adaptation of conservation objectives to reflect the current status of the system in which they are applied (McLeod et al. 2009). Moreover, effort dedicated toward misplaced, untenable objectives could potentially mask unintended change that would otherwise better inform adaptive management. In the case of the Eastport MPA, protection of juvenile Atlantic cod (Novaczek et al. 2017) provides a residual, but unmonitored, benefit of the MPA; this renders unlikely any changes to the design of the MPA to improve or better highlight this protection.

Although MPA advocates generally predict net positive effects of MPA closures (e.g., Caveen et al. 2014; Halpern and Warner 2002; Lester et al. 2009), others suggest that not all biological responses to protection result in systems better than they were prior to the management intervention (e.g. Agardy et al. 2011; Verhulst et al. 2004). Concluding whether the state of the marine system has changed in response to protection, and whether that change is positive, requires a foundation of clear and testable objectives and effective monitoring both inside and outside the MPA (Pascual et al. 2017).

Most marine ecologists expect some sort of biological effect with an MPA if the designation alters human activities that directly or indirectly interact with some component of the local biota, though specific effects and time frames are not always easy to predict. For example, the original northern cod moratorium was expected to last just a few years, but the stock remained extremely low for more than 20 years. During that time the ecosystem responded unpredictably, with increased abundance of shrimp and crab rather

than cod. This change increased the net landed value of the fishery overall while redistributing the benefits very differently. Increasing scientific evidence suggests that benefits may differ from original goals and emphasizes the importance of scientific monitoring and adaptive management.

Challenges: The Need for Local Support, Engagement, and Monitoring

Support for MPAs comes from early and broad-based consultations. Opposition to MPAs often comes from stakeholders directly impacted by the creation of a Marine Protected Area who may perceive a reduction or loss in commercial or recreational access. Sometimes this perception reflects reality whereas other cases reflect limited information and/or misunderstanding. Consultations can and should identify overlapping activities, if any, and determine means to mitigate potential effects. Informative discussions and inclusive decision-making can often help to build considerable support and produce solutions that address the needs and desires of a wide range of stakeholders (Epstein 2017).

Success of MPAs in Canada and internationally hinges upon thoughtful selection of a diverse portfolio of MPAs and MPA networks (multiple interconnected MPAs) designed to meet specific, attainable, and measurable conservation targets developed in consultation with diverse stakeholders and then followed with sustained monitoring and adaptive management. For the MPA case studies presented here, Fisheries and Oceans Canada proposes five-year re-evaluation cycles to adapt monitoring and MPA policy measures/conservation objectives. This long-term view communicates commitment to conservation, noting that most MPAs are implemented to provide long-term protection for valued components of an inherently dynamic ecosystem.

Western nations, including the United States, France, and the United Kingdom, have substantially increased marine protection by establishing large offshore MPAs, but by placing this protection in areas largely devoid of fishing activity (Devillers et al. 2015; Watson et al. 2004), while simultaneously leaving relatively heavily exploited coastal ecosystems, and associated biodiversity, at risk. Small, targeted MPAs can be a valuable tool for protection against specific threats that cannot be addressed by large MPAs, pointing to the importance of a mixed strategy of MPA design tuned to specific conservation objectives.

Changes in government priorities can result in rapid shifts in conservation efforts, and these shifts can occur on timescales far more rapid than ecosystem declines or recoveries. For example, the strong current emphasis on MPAs in Canada juxtaposes reduced enthusiasm over the prior decade but also coincides with a reversal of previous MPA advances in Australia and (potentially) the United States. These shifts in priorities underscore the importance of stakeholder engagement and garnering public support for marine conservation efforts in order to ensure long-term ocean sustainability.

Further Reading

Convention on Biological Diversity. 2010. *COP Decision X/2. Strategic Plan for Biodiversity 2011–2020*. Available at: http://www.cbd.int/decision/cop/?id=12268. Accessed 1 June 2017.

O'Leary, B.C., M. Winther-Janson, J.M. Bainbridge, J. Aitken, J.P. Hawkins, and C.M. Roberts. 2016. Effective Coverage Targets for Ocean Protection. *Conservation Letters* 9: 398–404.

World Parks Congress. 2014. *A Strategy of Innovative Approaches and Recommendations to Enhance Implementation of Marine Conservation in the Next Decade*. Available at: http://worldparkscongress.org/downloads/approaches/ThemeM.pdf. Accessed 1 June 2017.

References

Abecasis, D., P. Afonso, and K. Erzini. 2014. Combining Multispecies Home Range and Distribution Models Aids Assessment of MPA Effectiveness. *Marine Ecology Progress Series* 513: 155–169.

Agardy, T., P. Bridgewater, M.P. Crosby, J. Day, P.K. Dayton, R. Kenchington, D. Laffoley, P. McConney, P.A. Murray, J.E. Parks, and L. Peau. 2003. Dangerous Targets? Unresolved Issues and Ideological Clashes Around Marine Protected Areas. *Aquatic Conservation: Marine and Freshwater Ecosystems* 13 (4): 353–367.

Agardy, T., G.N. di Sciara, and P. Christie. 2011. Mind the Gap Addressing the Shortcomings of Marine Protected Areas Through Large Scale Marine Spatial Planning. *Marine Policy* 35 (2): 226–232.

Aiken, D.E., and S.L. Waddy. 1986. Environmental Influence on Recruitment of the American Lobster, *Homarus Americanus* – A Perspective. *Canadian Journal of Fisheries and Aquatic Sciences* 43 (11): 2258–2270.

Attard, J., and C. Hudon. 1987. Embryonic-Development and Energetic Investment in Egg-Production In Relation to Size of Female Lobster (*Homarus Americanus*). *Canadian Journal of Fisheries and Aquatic Sciences* 44 (6): 1157–1164.

Benestan, L., T. Gosselin, C. Perrier, B. Sainte-Marie, R. Rochette, and L. Bernatchez. 2015. RAD Genotyping Reveals Fine-Scale Genetic Structuring and Provides Powerful Population Assignment in a Widely Distributed Marine Species: The American Lobster (*Homarus americanus*). *Molecular Ecology* 24 (13): 3299–3315.

Bergseth, B.J., D.H. Williamson, G.R. Russ, S.G. Sutton, and J.E. Cinner. 2017. A Social–Ecological Approach to Assessing and Managing Poaching by Recreational Fishers. *Frontiers in Ecology and the Environment* 15 (2): 67–73.

Bradbury, I.R., S. Hubert, B. Higgins, S. Bowman, I.G. Paterson, P.V.R. Snelgrove, C.J. Morris, R.S. Gregory, D.C. Hardie, T. Borza, and P. Bentzen. 2011. Evaluating SNP Ascertainment Bias and Its Impact on Population Assignment in Atlantic Cod, *Gadus Morhua*. *Molecular Ecology Resources* 11: 218–225.

Burdett-Coutts, V. 2011. *Larval Supply, Settlement, and Recruitment of American Lobster*, Homarusamericanus. St. John's: Biology, Memorial University of Newfoundland.

Canada. 2005. *Canada's Federal Marine Protected Areas Strategy*. Ottawa: Government of Canada.

Caveen, A., N. Polunin, T. Gray, and S.M. Stead. 2014. *The Controversy Over Marine Protected Areas: Science Meets Policy*. Cham: Springer.

CBD-UNEP. 2010. *Aichi Biodiversity Targets*. https://www.cbd.int/sp/targets.

Charles, A., and L. Wilson. 2009. Human Dimensions of Marine Protected Areas. *ICES Journal of Marine Science* 66 (1): 6–15.

Chasse, J., and R.J. Miller. 2010. Lobster Larval Transport in the Southern Gulf of St. Lawrence. *Fisheries Oceanography* 19 (5): 319–338.

Christie, P., and A.T. White. 2007. Best Practices for Improved Governance of Coral Reef Marine Protected areas. *Coral Reefs* 26 (4): 1047–1056.

Claudet, J. 2010. *Marine Protected Areas: A Multidisciplinary Approach*. New York: Cambridge University Press.

———. 2017. Six Conditions Under Which MPAs Might Not Appear Effective (When They Are). *ICES Journal of Marine Science*. https://doi.org/10.1093/icesjms/fsx074.

Collins, R., and J. Lien. 2002. In Our Own Hands: Community-based Lobster Conservation in Newfoundland (Canada). *Biodiversity* 3 (2): 11–14.

Cook, R., J.M. Farinas-Franco, F.R. Gell, R.H.F. Holt, T. Holt, C. Lindenbaum, J.S. Porter, R. Seed, L.R. Skates, T.B. Stringell, and W.G. Sanderson. 2013. The Substantial First Impact of Bottom Fishing on Rare Biodiversity Hotspots: A Dilemma for Evidence-based Conservation. *PLoS One* 8 (8): e69904.

Cooper, R.A., and J.R. Uzmann. 1980. *Ecology of Juvenile and Adult Homarus*. New York: Academic Press.

COSEWIC. 2010. *COSEWIC Assessment and Status Report on the Atlantic Cod* (Gadus morhua) *in Canada.* Ottawa: COSEWIC

Currie, J.J., and D.C. Schneider. 2011. Spatial Scaling from Latitudinal Gradients, Size and Specific Fecundity in the American Lobster *Homarus Americanus*. *Marine Ecology Progress Series* 439: 193–201.

Davis, R., J. Whalen, and B. Neis. 2006. From Orders to Borders: Toward a Sustainable Co-managed Lobster Fishery in Bonavista Bay, Newfoundland. *Human Ecology* 34 (6): 851–867.

De Santo, E.M. 2013. Missing Marine Protected Area (MPA) Targets: How the Push for Quantity Over Quality Undermines Sustainability and Social Justice. *Journal of Environmental Management* 124: 137–146.

Dean, M.J., W.S. Hoffman, D.R. Zemeckis, and M.P. Armstrong. 2014. Fine-scale Diel and Gender-based Patterns in Behaviour of Atlantic Cod (*Gadus morhua*) on a Spawning Ground in the Western Gulf of Maine. *ICES Journal of Marine Science* 71 (6): 1474–1489.

den Heyer, C.E., E.M.P. Chadwick, and J.A. Hutchings. 2009. Diffusion of American Lobster (*Homarus americanus*) in Northumberland Strait, Canada. *Canadian Journal of Fisheries and Aquatic Sciences* 66 (4): 659–671.

Devillers, R., R.L. Pressey, A. Grech, J.N. Kittinger, G.J. Edgar, T. Ward, and R. Watson. 2015. Reinventing Residual Reserves in the Sea: Are We Favouring Ease of Establishment Over Need for Protection? *Aquatic Conservation: Marine and Freshwater Ecosystems* 25 (4): 480–504.

DFO. 2010. *Review of the Gilbert Bay Marine Protected Area (MPA) Monitoring Indicators, Protocols, and Strategies, and an Assessment of the Gilbert Bay Cod Population*, Canadian Science Advisory Secretariat Science Advice Report 2010/027(12 pp).

———. 2013a. *An Assessment of the American Lobster in Newfoundland*, DFO Canadian Science Advisory Secretariat Science Advisory Report 2013/068.

———. 2013b. *Eastport Marine Protected Areas Management Plan: 2013–18*. 48 pp. http://www.icomnl.ca/files/DFO%20Eastport%20Booklet%20-%20English%202013%20PDF_Low%20Res.pdf.

———. 2016. *Guidance on Identifying "Other Effective Area-Based Conservation Measures" in Canadian Coastal and Marine Waters*, Canadian Science Advisory Secretariat National Capital Region Science Advisory Report. 2016/002.

———. 2017a. *Adapting Monitoring Protocols and Strategies for the Gilbert Bay Marine Protected Area*, Canadian Science Advisory Secretariat Science Advice Report 2017/021: 8 pp.

———. 2017b. *Lobster Area Closures (Trout River, Shoal Point, Penguin Islands, Gooseberry Island, Glovers Harbour, Mouse Island, Gander Bay)*. http://www.dfo-mpo.gc.ca/oceans/oeabcm-amcepz/refuges/lobster-homard-eng.html. Accessed June 2017.

Edgar, G.J., R.D. Stuart-Smith, T.J. Willis, S. Kininmonth, S.C. Baker, S. Banks, N.S. Barrett, M.A. Becerro, A.T.F. Bernard, J. Berkhout, C.D. Buxton, S.J. Campbell, A.T. Cooper, M. Davey, S.C. Edgar, G. Forsterra, D.E. Galvan, A.J. Irigoyen, D.J. Kushner, R. Moura, P.E. Parnell, N.T. Shears, G. Soler, E.M.A. Strain, and R.J. Thomson. 2014. Global Conservation Outcomes Depend on Marine Protected Areas with Five Key Features. *Nature* 506 (7487): 216–220.

Ennis, G.P. 2011. Closed Areas as a Conservation Strategy in the Newfoundland Lobster Fishery. *Biodiversity* 12 (1): 11–20.

Epstein, G. 2017. Local Rulemaking, Enforcement and Compliance in State-Owned Forest Commons. *Ecological Economics* 131: 312–321.

FAO. 2012. *The State of the World Fisheries and Aquaculture Organisation of the United Nations (FAO)*. Rome: Food and Agriculture Organization, 209 pp.

———. 2016. *The State of World Fisheries and Aquaculture 2016: Contributing to Food Security and Nutrition for All*. Rome: Food and Agriculture Association of the United Nations, 200 pp.

Frank, K.T., and D. Brickman. 2000. Allee Effects and Compensatory Population Dynamics Within a Stock Complex. *Canadian Journal of Fisheries and Aquatic Sciences* 57 (3): 513–517.

FRCC. 1995. *A Conservation Framework for Atlantic Lobster: Report to the Minister of Fisheries and Oceans*, Fisheries Resource Conservation Council FRCC95.R.1.

Garcia, S.M., J. Kolding, J. Rice, M.J. Rochet, S. Zhou, T. Arimoto, J.E. Beyer, L. Borges, A. Bundy, D. Dunn, E.A. Fulton, M. Hall, M. Heino, R. Law, M. Makino, A.D. Rijnsdorp, F. Simard, and A.D.M. Smith. 2012. Reconsidering the Consequences of Selective Fisheries. *Science* 335 (6072): 1045–1047.

Garcia-Charton, J.A., A. Perez-Ruzafa, C. Marcos, J. Claudet, F. Badalamenti, L. Benedetti Cecchi, J.M. Falcon, M. Milazzo, P.J. Schembri, B. Stobart, F. Vandeperre, A. Brito, R. Chemello, M. Dimech, P. Domenici, I. Guala, L. Le Direach, E. Maggi, and S. Planes. 2008. Effectiveness of European Atlanto-Mediterranean MPAs: Do They Accomplish the Expected Effects on Populations, Communities and Ecosystems? *Journal for Nature Conservation* 16 (4): 193–221.

Gill, D.A., M.B. Mascia, G.N. Ahmadia, L. Glew, S.E. Lester, M. Barnes, I. Craigie, E.S. Darling, C.M. Free, J. Geldmann, S. Holst, O.P. Jensen, A.T. White, X. Basurto, L. Coad, R.D. Gates, G. Guannel, P.J. Mumby, H. Thomas, S. Whitmee, S. Woodley, and H.E. Fox. 2017. Capacity Shortfalls Hinder the Performance of Marine Protected Areas Globally. *Nature* 543 (7647): 665–669.

Goni, R., R. Hilborn, D. Diaz, S. Mallol, and S. Adlerstein. 2010. Net Contribution of Spillover from a Marine Reserve to Fishery Catches. *Marine Ecology Progress Series* 400: 233–243.

Government of Canada. 2016. 2020 Biodiversity Goals and Targets for Canada. *Biodivcanada.ca*.

Halpern, B.S. 2003. The Impact of Marine Reserves: Do Reserves Work and Does Reserve Size Matter? *Ecological Applications* 13 (1): S117–S137.

Halpern, B.S., and R.R. Warner. 2002. Marine Reserves Have Rapid and Lasting Effects. *Ecology Letters* 5 (3): 361–366.

Hilborn, R. 2017. Food for Thought: Are MPAs Effective? *ICES Journal of Marine Science.* https://doi.org/10.1093/icesjms/fsx068.

Hilborn, R., K. Stokes, J.J. Maguire, T. Smith, L.W. Botsford, M. Mangel, J. Orensanz, A. Parma, J. Rice, J. Bell, K.L. Cochrane, S. Garcia, S.J. Hall, G.P. Kirkwood, K. Sainsbury, G. Stefansson, and C. Walters. 2004. When Can Marine Reserves Improve Fisheries Management? *Ocean and Coastal Management* 47 (3–4): 197–205.

Incze, L., H.J. Xue, N. Wolff, D. Xu, C. Wilson, R. Steneck, R. Wahle, P. Lawton, N. Pettigrew, and Y. Chen. 2010. Connectivity of Lobster (*Homarus americanus*) Populations in the Coastal Gulf of Maine: Part II. Coupled Biophysical Dynamics. *Fisheries Oceanography* 19 (1): 1–20.

IUCN. 2004. *How Is Your MPA Doing? A Guidebook of Natural and Social Indicators for Evaluating Marine Protected Area Management Effectiveness*. Cambridge, UK: The World Conservation Union.

Janes, J. 2009. *Assessing Marine Protected Areas as a Conservation Tool: A Decade Later, Are We Continuing to Enhance Lobster Populations at Eastport, Newfoundland?* Canadian Technical Report of Fisheries and Aquatic Sciences 2832, pp. 43.

Janes, J.M., C. J. Morris, E.J. Bennet, and J.M. Green 2009. *Gilbert Bay Marine Protected Area Monitoring Plan*. Oceans, Habitat and Species at Risk Publication Series, Newfoundland and Labrador Region 0001, pp. 12.

Kilada, R., B. Sainte-Marie, R. Rochette, N. Davis, C. Vanier, and S. Campana. 2012. Direct Determination of Age in Shrimps, Crabs, and Lobsters. *Canadian Journal of Fisheries and Aquatic Sciences* 69 (11): 1728–1733.

Knutsen, H., E.M. Olsen, L. Ciannelli, S.H. Espeland, J.A. Knutsen, J.H. Simonsen, S. Skreslet, and N.C. Stenseth. 2007. Egg Distribution, Bottom Topography and Small-scale Cod Population Structure in a Coastal Marine System. *Marine Ecology Progress Series* 333: 249–255.

Kurlansky, M. 1998. *Cod: A Biography of the Fish that Changed the World*. New York: Penguin books.

Laurel, B.J., and I.R. Bradbury. 2006. 'Big' Concerns with High Latitude Marine Protected Areas (MPAs): Trends in Connectivity and MPA Size. *Canadian Journal of Fisheries and Aquatic Sciences* 63 (12): 2603–2607.

Lester, S.E., and B.S. Halpern. 2008. Biological Responses in Marine No-take Reserves Versus Partially Protected Areas. *Marine Ecology Progress Series* 367: 49–56.

Lester, S.E., B.S. Halpern, K. Grorud-Colvert, J. Lubchenco, B.I. Ruttenberg, S.D. Gaines, S. Airame, and R.R. Warner. 2009. Biological Effects Within No-take Marine Reserves: A Global Synthesis. *Marine Ecology Progress Series* 384: 33–46.

Lewis, S., E. Coughlan, P. Pepin, and K.R. Skanes 2017. *An Assessment of the Biological Indicators for the Eastport Marine Protected Area (MPA): A Case Study in Support of an Ecosystem Goods and Services Valuation of MPAs*, Canadian Science Advisory Secretariat Research Document 2017/001: 51.

Lubchenco, J., and K. Grorud-Colvert. 2015. Making Waves: The Science and Politics of Ocean Protection. *Science* 350 (6259): 382–383.

McLeod, E., R. Salm, A. Green, and J. Almany. 2009. Designing Marine Protected Area Networks to Address the Impacts of Climate Change. *Frontiers in Ecology and the Environment* 7 (7): 362–370.

Micheli, F., B.S. Halpern, L.W. Botsford, and R.R. Warner. 2004. Trajectories and Correlates of Community Change in No-take Marine Reserves. *Ecological Applications* 14 (6): 1709–1723.

Morris, C.J., and J.M. Green. 2002. Biological Characteristics of a Resident Population of Atlantic Cod (*Gadus morhua* L.) in Southern Labrador. *ICES Journal of Marine Science* 59 (4): 666–678.

Morris, C., and J.M. Green. 2010. *The Gilbert Bay Marine Protected Area Atlantic Cod Science Monitoring Program*, Department of Fisheries and Oceans Canadian Science Advisory Secretariat Research Document 60.

Morris, C.J., and J.M. Green. 2014. MPA Regulations Should Incorporate Adaptive Management-The Case of Gilbert Bay Labrador Atlantic Cod (*Gadus morhua*). *Marine Policy* 49: 20–28.

———. In prep. Changes in the Fish Community May Have Consequences for the Gilbert Bay Marine Protected Area.

Morris, C.J., J.M. Green, P.V.R. Snelgrove, C.J. Pennell, and L.M.N. Ollerhead. 2014. Temporal and Spatial Migration of Atlantic Cod (*Gadus morhua*) Inside and Outside a Marine Protected Area and Evidence for the Role of Prior Experience in Homing. *Canadian Journal of Fisheries and Aquatic Sciences* 71 (11): 1704–1712.

MPAtlas. 2017. *Atlas of Marine Protection*. Accessed http://www.mpatlas.org/2017.

Novaczek, E., V. Howse, C. Pretty, R. Devillers, E. Edinger, and A. Copeland. 2017. Limited Contribution of Small Marine Protected Areas to Regional Biodiversity: The Example of a Small Canadian No-take MPA. *Frontiers in Marine Science* 4: 174.

Olsgard, F., M.T. Schaanning, S. Widdicombe, M.A. Kendall, and M.C. Austen. 2008. Effects of Bottom Trawling on Ecosystem Functioning. *Journal of Experimental Marine Biology and Ecology* 366 (1–2): 123–133.

Pascual, U., I. Palomo, W. Adams, K. Chan, T. Daw, E. Garmendia, E. Gómez-Baggethun, R. de Groot, G. Mace, and B. Martin-Lopez. 2017. Off-stage Ecosystem Service Burdens: A Blind Spot for Global Sustainability. *Environmental Research Letters* 12 (7): 075001.

Pelc, R.A., R.R. Warner, S.D. Gaines, and C.B. Paris. 2010. Detecting Larval Export from Marine Reserves. *Proceedings of the National Academy of Sciences of the United States of America* 107 (43): 18266–18271.

Pendleton, L.H., G.N. Ahmadia, H.I. Browman, R.H. Thurstan, D.M. Kaplan, and V. Bartolino 2017. Debating the Effectiveness of Marine Protected Areas. *ICES Journal of Marine Science.* https://doi.org/10.1093/icesjms/fsx154.

Perry, A.L., P.J. Low, J.R. Ellis, and J.D. Reynolds. 2005. Climate Change and Distribution Shifts in Marine Fishes. *Science* 308 (5730): 1912–1915.

Pomeroy, R.S., L.M. Watson, J.E. Parks, and G.A. Cid. 2005. How Is Your MPA Doing? A Methodology for Evaluating the Management Effectiveness of Marine Protected Areas. *Ocean and Coastal Management* 48 (7–8): 485–502.

Roberts, C.M., B.C. O'Leary, D.J. McCauley, P.M. Cury, C.M. Duarte, J. Lubchenco, D. Pauly, A. Sáenz-Arroyo, U.R. Sumaila, and R.W. Wilson. 2017. Marine Reserves can Mitigate and Promote Adaptation to Climate Change. *Proceedings of the National Academy of Sciences of the United States of America* 114 (24): 6167–6175.

Robichaud, D., and G.A. Rose. 2001. Multiyear Homing of Atlantic Cod to a Spawning Ground. *Canadian Journal of Fisheries and Aquatic Sciences* 58 (12): 2325–2329.

———. 2004. Migratory Behaviour and Range in Atlantic Cod: Inference from a Century of Tagging. *Fish and Fisheries* 5 (3): 185–214.

Rowe, S. 2001. Movement and Harvesting Mortality of American Lobsters (*Homarus Americanus*) Tagged Inside and Outside No-take Reserves in Bonavista Bay, Newfoundland. *Canadian Journal of Fisheries and Aquatic Sciences* 58 (7): 1336–1346.

———. 2002. Population Parameters of American Lobster Inside and Outside No-take Reserves in Bonavista Bay, Newfoundland. *Fisheries Research* 56 (2): 167–175.

Salvanes, A.G.V., J.E. Skjaeraasen, and T. Nilsen. 2004. Sub-populations of Coastal Cod with Different Behaviour and Life-history Strategies. *Marine Ecology Progress Series* 267: 241–251.

Schindler, D.E., R. Hilborn, B. Chasco, C.P. Boatright, T.P. Quinn, L.A. Rogers, and M.S. Webster. 2010. Population Diversity and the Portfolio Effect in an Exploited Species. *Nature* 465 (7298): 609–612.

Sinclair-Waters, M. 2017. *Genomic Perspectives for Conservation and Management of Atlantic Cod in Coastal Labrador*. Halifax: Biology, Dalhousie University.

Skjaeraasen, J.E., J.J. Meager, O. Karlsen, J.A. Hutchings, and A. Ferno. 2011. Extreme Spawning Site Fidelity in Atlantic Cod. *ICES Journal of Marine Science* 68 (7): 1472–1477.

Smedbol, R.K., and R. Stephenson. 2001. The Importance of Managing within-species Diversity in Cod and Herring Fisheries of the North-western Atlantic. *Journal of Fish Biology* 59: 109–128.

Stanley, R.R.E., E.J. Pedersen, and P.V.R. Snelgrove. 2016. Biogeographic, Ontogenetic, and Environmental Variability in Larval Behaviour of American Lobster (*Homarus americanus*). *Marine Ecology Progress Series* 553: 125–146.

Staub, F., and M.E. Hatziolos. 2004. *Score Card to Assess Progress in Achieving Management Effectiveness Goals for Marine Protected Areas*. Washington, DC: World Bank.

Stewart, G.B., M.J. Kaiser, I.M. Cote, B.S. Halpern, S.E. Lester, H.R. Bayliss, and A.S. Pullin. 2009. Temperate Marine Reserves: Global Ecological Effects and Guidelines for Future Networks. *Conservation Letters* 2 (6): 243–253.

Toonen, R.J., K.R. Andrews, I.B. Baums, C.E. Bird, G.T. Concepcion, T.S. Daly-Engel, J.A. Eble, A. Faucci, M.R. Gaither, M. Iacchei, J.B. Puritz, J.K. Schultz, D.J. Skillings, M.A. Timmers, and B.W. Bowen. 2011. Defining Boundaries for Ecosystem-based Management: A Multispecies Case Study of Marine Connectivity Across the Hawaiian Archipelago. *Journal of Marine Biology*. Article ID 460173.

Verhulst, S., K. Oosterbeek, A.L. Rutten, and B.J. Ens. 2004. Shellfish Fishery Severely Reduces Condition and Survival of Oystercatchers Despite Creation of Large Marine Protected Areas. *Ecology and Society* 9(1) 1:10.

Wahle, R.A., and R.S. Steneck. 1992. Habitat Restrictions in Early Benthic Life – Experiments on Habitat Selection and in Situ Predation with the American Lobster. *Journal of Experimental Marine Biology and Ecology* 157 (1): 91–114.

Walters, C. 2000. Impacts of Dispersal, Ecological Interactions, and Fishing Effort Dynamics on Efficacy of Marine Protected Areas: How Large Should Protected Areas Be? *Bulletin of Marine Science* 66 (3): 745–757.

Watson, R., A. Kitchingman, A. Gelchu, and D. Pauly. 2004. Mapping Global Fisheries: Sharpening Our Focus. *Fish and Fisheries* 5 (2): 168–177.

Part II

Equity

The focus on equity is what separates sustainability from other environmental disciplines like environmental science or policy. Many people around the world do not share equally the benefits of environmental protection and do not share the burden of pollution and other environmental problems. Some of the problems associated with equity are long standing and are associated with systemic problems like colonialism, racism, and generational poverty. Others are new and can be linked to war, climate change, and increasing income inequality. Millions of people have become environmental refugees and millions more are unable to achieve all that they can be due to limiting factors (such as lead pollution in Flint, Michigan's water) that are present in their environment or society.

The group of 11 chapters in this section reflects upon the issue of social equity and demonstrate what people are doing to address inequality. From Japanese activists working to stop radiation poisoning to small-scale organic farmers in Florida, people all over the world are trying to educate broader society and improve the lives of others. Leadership seems to be an underlying theme in this section. The group of chapters demonstrates that individuals can make profound differences in the lives of others and in the future of their communities. Also, this section notes that governments, non-profit organizations, and community groups can be leaders and drivers of change.

12

Urban Social Sustainability: The Case Study of Nottingham, UK

Jenni Cauvain

Background

While social sustainability can be investigated through a plurality of empirical and theoretical pathways, socio-economic inequality is coherent with the tradition of urban scholarship and thus it serves as the empirical focus in this case study. There is a gap in research in this area as mainstream social sustainability and inequality literatures are not focused on the city scale, indeed there are methodological challenges in doing so, discussed later in this chapter. Furthermore, there are two notable intellectual trends in sustainability research and policy; one is the rise of cities as a locus of research owing to global urbanization. The simple majority of the world's population is known to be urban dwellers since 2006 when the United Nations (UN) declared this demographic tipping point (Soja and Kanai 2014). The second trend relates to the emphasis on inequality, particularly in a socio-economic sense, as a global challenge. The success of Thomas Piketty's Capital in the twenty-first century has given credence to the inequality debate, and now inequality is addressed by mainstream institutions such as the International Monetary Fund (IMF) (Economist June 15, 2015). It has been suggested that in rich societies, the link between economic development and quality of life has been broken because of inequality and that the level of inequality experienced in advanced economies contributes to unsustainable consumption habits and unsustainable growth (Wilkinson and Pickett 2014).

J. Cauvain (✉)
School of Sociology and Social Policy, University of Nottingham, Nottingham, Nottinghamshire, UK

R. Brinkmann, S. J. Garren (eds.), *The Palgrave Handbook of Sustainability*,
https://doi.org/10.1007/978-3-319-71389-2_12

To highlight the twin trends of inequality and urbanization, the UN adopted 17 new sustainability goals in January 2016 and dedicated one goal for inequality and another for cities; Goal 10 is "Reduce inequalities within and among countries" and Goal 11 is "Make cities inclusive, safe, resilient and sustainable." Notably, despite the focus on cities in their own right for the first time, the UN discusses inequality primarily at national and international scales. Indeed, the nation-state seems to be the default locus of socio-economic inequality research and debate, but there is a case to be made for urban understandings of this phenomenon as a sustainability challenge. This chapter serves that purpose.

Social Sustainability in Literature

Social sustainability is debated in several branches of academic literature. In what might be termed sustainable development literature, there is often a focus on international development and global poverty alleviation (Daly 1990; Griggs et al. 2013). Conceptual or review-style papers put forward different definitions of social sustainability (e.g. Cuthill 2010; Murphy 2012). Vallance et al. (2011) propose a three-tier framework for social sustainability: (1) *development sustainability* addressing basic needs, the creation of social capital, justice, and so on; (2) *bridge sustainability* concerning changes in human behavior so as to achieve bio-physical environmental goals; and (3) *maintenance sustainability* referring to the preservation—or what can be sustained—of socio-cultural characteristics in the face of change. By contrast, the urban literature often considers economic restructuring, inequalities, political power, and governance in urban contexts (Haughton 1999; Imrie and Loretta 2014; Maloutas 2003). In urban planning literature, the compact city is traditionally associated with notions of environmental sustainability. The relationship between residential density and social sustainability—conceived of as social cohesion, social capital, and quality of life—has received some attention in literature (Bramley and Power 2009; Dave 2011; Dempsey et al. 2011).

Polese and Stren (2000) argue that social sustainability is an important and challenging goal for all cities; their edited volume offers perspectives across developed and emerging urban economies. The common thread that unites cities across the world is that they attract urban populations of "vastly differing social, cultural, and ethnic backgrounds" who co-exist in the urban system (p. 8). Thus, Polese and Stren (2000) define urban social sustainability as:

> *development (and/or growth) that is compatible with the harmonious evolution of civil society, fostering an environment conducive to the compatible cohabitation of culturally and socially diverse groups while at the same time encouraging social integration with improvements in the quality of life for all segments of the population.* (2000, 15–16)

The central argument that can be taken from the above definition is one of social justice; urban development should improve everyone's quality of life. Polese and Stren's argument contains an underlying positive assumption—that quality of life indeed improves with urbanization. We might modify this assumption to take an account of the negative impacts of urbanization, and for the purposes of this chapter, social sustainability is understood as a just distribution of the benefits and burdens of urbanization, be it environmental, social, or economic.

In addition to the above, there is a specific branch of social scientific effort that seeks to align sociological thinking with ecological concerns (Blackstock et al. 2005) sometimes termed environmental sociology (Lidskog et al. 2014). Environmental sociology is related to the environmental justice literature (Cole and Foster 2001); both focus on society-environment interactions. The science and technology studies tradition applies a social lens to scientific and often industrial developments in a multitude of areas that incorporate socio-environmental perspectives on sustainability (Lehtonen 2011), often with a focus on perceptions and attitudes to such developments. These studies could be characterized as aligned along various sectoral interests, rather than "urban issues," although in many cases there are overlaps. This diversity has attracted critique from within the academe. Vallance et al. (2011) assert that the social sustainability concept is "in chaos." Others take a more moderate view, accepting that there is no overall definition because of "diverging study perspectives and discipline-specific criteria" (Colantonio 2010, 79).

In conclusion, each discipline and each study adopts a focus relevant to them when it comes to social sustainability, but there is a central organizing theme. The body of work on social sustainability points toward social justice as a core concept in theorizing and investigating social sustainability. Next, we focus on what is social justice and how it could be understood in the urban context.

Social Justice and Right to the City

The intellectual foundations of a just city in much of contemporary urban scholarship are in Lefebvre's (1968) *Le droit a la ville* (Right to the City) (Purcell 2014). Outside of academic writing, the Right to the City slogan has also been coopted by organizations such as UN-Habitat and UNESCO in their manifestos coupling urban sustainability with human rights (Purcell 2014, 141). Social sustainability

in the urban context is based on core concepts and values that originate in the Right to the City—social justice, democracy, and human rights**.** Merrifield and Swyngedouw (1996) highlight the importance of urban scholarship to questions of justice by tracing urban social phenomena such as homelessness, job losses, poverty, housing deprivation, and violence in cities. The urban literature also contains some of the more critical perspectives on sustainability, arguing that the mainstream notions of sustainability serve the existing economic and political status quo (Cook and Swyngedouw 2012; Swyngedouw and Kaika 2014). Soja (2010) is associated with the term "spatial justice" and his work is pivotal in critical geography investigating the unequal impacts of urbanization. Soja too advocates the human rights approach in urban justice thinking. The critique of sustainable development in the urban tradition calls for research to focus on inequalities. The idea of social reproduction is central to the critique of sustainable development: on the one hand, how societal injustices are propagated through the existing networks of power, wealth, and privilege, and on the other hand, how the everyday lives of residents produce and reproduce the urban space.

If social justice is the cornerstone of social sustainability, and "An equitable society is one in which there are no 'exclusionary' or discriminatory practices hindering individuals from participating economically, socially and politically in society" (Dempsey et al. 2011, 292), then governance and access to goods, services, justice, and so on are important in the context of social reproduction of the urban. A cursory look at literature confirms that a multitude of barriers prevent disadvantaged citizens from participation, representation, recognition, and justice in the urban and urbanizing world—the environmental justice literature (Holifield et al. 2009) is particularly poignant in urban debates. Poverty, among other disadvantages, is a wholesome barrier to justice.

Furthermore, research has revealed the inadequacies of localized responses (to sustainability) without broader concern for geographical and social displacement of the environmental and social costs of urban development for present and future generations (Haughton 1999). This is a specific challenge for urban sustainability research. For the established case study approach, also deployed in this chapter, this point of view highlights obvious limitations of the method. These limitations to an extent can be addressed through investigating how a city responds to not only injustices within its own boundaries but how it steps forward to address cross-border challenges and how it takes into account the impact of present policies and conditions on future generations. Detailed analysis of intergenerational and cross-border challenges is outside of the scope of this case study; however, the impact of present social conditions on children will be raised as a concern for intergenerational equity.

Case Study

Introduction and Methodology

The case study of Nottingham investigates social and spatial justice as factors influencing the sustainability of the city. The research has two primary goals, first is to establish how the city fares in terms of social justice and, second, to understand the geography of socio-economic patterns of inequality within the urban context.

Focusing on a city, inequalities can be researched with a range of methods and indicators. The case study methodology is a mixed method approach using two main sources of data; it draws on a review of the city's policy documents and on secondary data analysis of government statistics. The focus is on socio-economic inequality measured mainly through income while also exploring other social statistics at the urban level including deprivation, educational attainment, and life expectancy. These indicators are investigated via comparison within the region and the nation as well as their geographic patterns within the urban boundary. The boundary is defined in line with the definition of "Greater Nottingham" which broadly reflects the functional economic area of the city. This includes the neighboring districts of Broxtowe, Gedling and Rushcliffe. The latter are defined as "two-tier local authorities"; they belong to the County of Nottinghamshire, therefore some local government functions (such as schools) are dealt with at the County Council level, as opposed to the local authority. By contrast, the City of Nottingham is a "unitary authority," meaning that there is no split between administrative functions; instead, the city is responsible for all local government affairs.

When investigating household incomes at a local and neighborhood level, researchers face significant limitations to data availability. The shortage of fine-grained data on incomes compromises any analysis of income inequality using established statistical tools often used in international contexts where the data is aggregated at a national level. Not only is data limited in its geographic granularity but higher incomes are underrepresented in the datasets that inform the creation of the national small area estimates for England. The methods of data collection are biased toward lower income households for the purposes of mapping poverty and deprivation. Therefore, the UK and predictably other nations too lack tools to analyze the true picture of wealth distribution at the local level, thus the picture of socio-economic inequality is blurred. Recognizing these limitations is necessary, but it is also useful to remember why inequality research at the local level is important. Advances made in this field are likely to contribute toward expanding the urban sustainability debate.

The data used in this case study refers to the latest most detailed small-area income estimates released by the UK government (Office of National Statistics 2016b)—this data provides estimates of the "average household income" as a single figure at the Middle Layer Super Output Area (MSOA) level. There are between 2000 and 6000 households in English MSOAs (5000–15,000 individuals). Public housing as a percentage of total housing stock is also mapped at the MSOA level to provide a socio-spatial context to the emerging patterns in the city region. Additionally, the study uses the Index of Multiple Deprivation (IMD) (Department for Communities and Local Government 2015). The IMD is a composite indicator that considers seven different domains of deprivation: these are income, employment, health, education, access to housing and services, crime, and physical environment. The IMD offers more granularity, with data available at the Lower Level Super Output Area (LSOA) which is a geographic unit between 400 and 1200 households.

Segregation is not measured via statistical means in this case study; instead, figures are presented to explore the relationship between space and disadvantage in the case study city. In terms of segregation, there is a wealth of literature in the Anglo-American tradition on the various negative impacts of high levels of segregation on racial or socio-economic grounds (Musterd 2005). One notable aspect of socio-economic segregation is that wealthy people are typically the most segregated social group in cities (Tammaru et al. 2016). On the relationship between inequality and segregation in Europe, Tammaru et al. (2016) conclude that high social inequality does not always produce high segregation. Many institutional, unique context-specific factors such as historic urban development patterns and cultural factors influence the extent to which social disparities are expressed in the urban space but they argue that there are four key areas that affect segregation:

- Socio-economic inequality
- Economic restructuring linked to globalization
- Welfare state
- Housing system

The case study makes reference to these factors to understand the socio-spatial structure of Nottingham.

Nottingham: A Sustainable City?

Nottingham is a regional center located in the East Midlands of England in the UK. Recent estimates suggest a population of 325,300 in the core city and 682,100 in the wider conurbation known as Greater Nottingham (including

Nottingham's neighboring districts of Broxtowe, Gedling, and Rushcliffe) (Nottingham City Council NCC 2017a). Compared with its suburban neighbors, the city of Nottingham is ethnically more diverse (34.7 percent Black and minority ethnic compared with 16.5 percent in the suburbs) and it attracts more international migrants; in 2016–2017 more than 75 percent of new migrants in Greater Nottingham were registered for national insurance purposes in the city (NCC 2017b) (see Table 12.1 for demographic data). Nottingham is a city of high internal population churn owing to its large student body; there are two universities in the city with a combined student population of over 60,000. There is currently a small net loss from internal migration each year, although overall the population is projected to increase albeit at a slower pace than that in England on average. Lower than average graduate retention rates, as well as the out-migration of working age families with children are among Nottingham City's policy concerns (Lawton and Blackley 2016).

In terms of environmental sustainability, Nottingham has built itself a reputation as a front-runner in England, if not Europe. Among the infrastructural highlights are one of Europe's largest fleets of electric buses, extended electric tram network, the UK's first local authority-owned energy retailer Robin Hood Energy, significant thermal insulation and solar PV schemes on residential housing, as well as an expanding district heating network (NCC 2017c). In 2016, the city exceeded its own carbon emission reduction targets. Behind these innovative and ambitious environmental programs is a proactive City Council that has successfully secured both national and European Union funds

Table 12.1 Comparing Nottingham in the region and nation

	England	Nottingham	Greater Nottingham
Population (Census 2011)	53,012,456	314,300	682,100
Average (mean) earnings pa	£34,300	£26,500 (by residence) £30,900 (by workplace)	£32,100 (by residence) £30,500 (by workplace)
Unemployment	1.8%	3.2%	2.2%
Ethnic diversity			
White British	79.8%	65.4%	79.1%
White Other	5.7%	5.1%	4.4%
Black and Minority Ethnic	14.5%	34.7%	16.5%
Percentage of children in low-income families (<£17,000 pa)	42.5%	64.8%	47.9%

Data sources: UK Census 2011; Annual Survey of Hours and Earnings 2015 (via Office of National Statistics); Job Seekers Allowance April 2016 (via Nomis); Nottingham City Council Child Poverty Note 2015

to invest in the city's low carbon-built environment (Sharzar et al. 2017). From the perspective of urban social sustainability, governance arrangements behind these initiatives are of interest to this case study. Nottingham City Council retains significant ownership of public assets which gives the local authority leverage through which it can achieve major sustainability initiatives. Nottingham City owns wholly or is a significant stakeholder in the companies who respectively run and/or contract the bus and tram services, the district heating network, public housing, and the newly established non-profit energy company. This is in contrast with many English local authorities where such assets have been fully privatized without the local authority retaining ownership under the new arrangements (Ginsburg 2005 about English public housing; Imrie and Loretta 2014 for a study of London). What is more, the City of Nottingham is considered politically stable having been governed by a Labor Party majority for nearly 30 years. However, not every politically stable city in England has embraced similar local governance strategies—the Nottingham case is an outlier in this respect. This short description offers a backdrop to the city that is next investigated in further detail in terms of social sustainability.

Income and Other Inequalities

While the environmental governance of Nottingham may be exemplary, from a social inequality perspective, the picture in Nottingham is challenging. With the absence of nationally comparable income data at a local level, the think tank Centre for Cities uses the difference between the percentages of Job Seekers Allowance claimants in the highest and lowest unemployment areas as a proxy for economic inequality (the geographic unit of analysis is LSOA, using the Primary Urban Area as a boundary which is slightly larger than the definition of Greater Nottingham used in the case study). According to this measure, Nottingham is the fourth most divided urban area in the UK from 64 cities—behind Nottingham are only Leeds, Birmingham, and Belfast (Centre for Cities 2015, 50).

Like many cities, Nottingham has higher levels of poverty than national averages. Within Greater Nottingham, the city has higher levels of unemployment and child poverty than the surrounding districts (Table 12.1, the child poverty definition used is that adopted by the City Council referring to families with children where total household income is £17,000 per annum or less). Nottingham's relative performance in terms of social deprivation has worsened in the same time period when the city's environmental schemes have come to fruition—its ranking in the English Index of Multiple Deprivation (IMD) was 20th most deprived local authority area in 2010, and

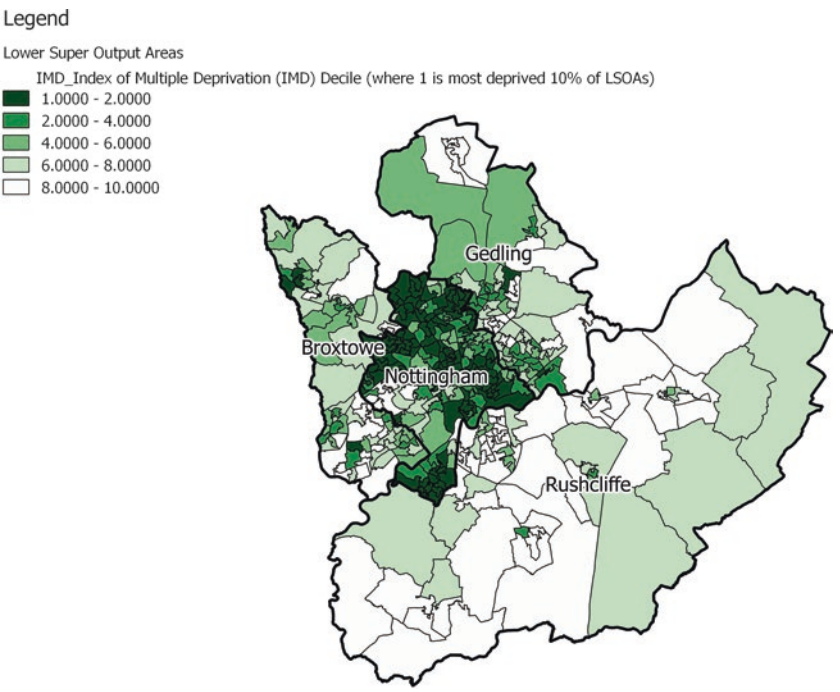


Fig. 12.1 Index of multiple deprivation 2015 (Decile ranking) in Greater Nottingham by LSOA (Data source: Index of multiple deprivation 2015. Contains National Statistics data © Crown copyright and database right [2017]. Contains OS data © Crown copyright [and database right] (2017))

this has changed to 8th most deprived in 2015. Part of the city known as Nottingham North is among the top five most deprived constituencies in England (NCC 2017a). Figure 12.1 for the latest IMD data, which shows Greater Nottingham LSOAs, coded according to their decile ranking in the national index. There is a significant concentration of Lower Super Output Areas in the most deprived 10 percent nationally within the city boundary of Nottingham.

Analysis of the different domains of deprivation suggests that the scores on health, education, and crime particularly affect Nottingham's poor rating nationally (NCC 2017a). A cursory overview of health in the city reveals a major disadvantage for Nottingham residents compared nationally and also within the city between the wealthiest and poorest areas: life expectancy for men is ranked 9th worst in England and 18th for women, while the life expectancy gap between the city's poorest and most affluent wards is 10 years. (Nottingham City Joint Needs Assessment 2013). Nottingham is faced with a myriad of social challenges closely related to poverty and inequality among

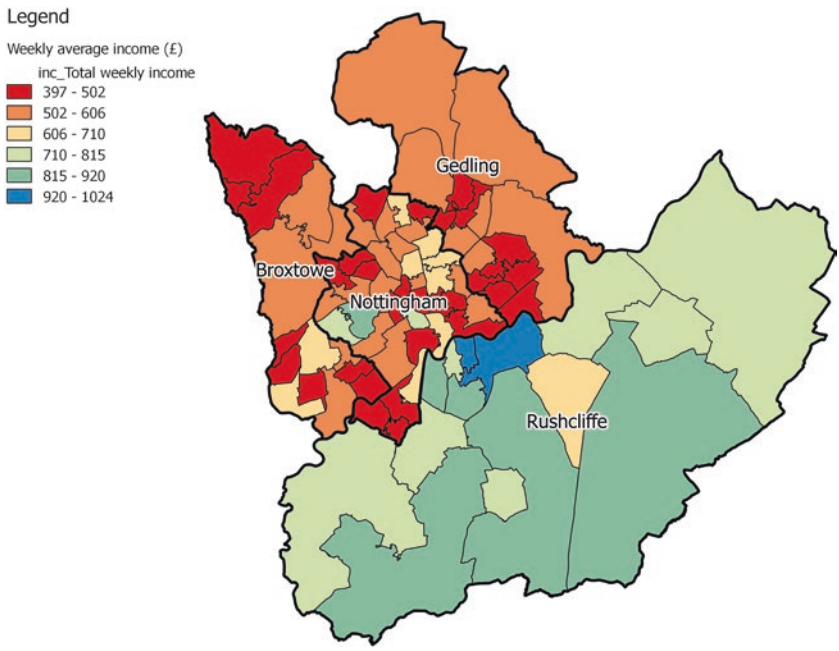


Fig. 12.2 Average household incomes in Greater Nottingham by MSOA (Data source, small area model-based income estimates; England and Wales, financial year ending 2014, ONS 2016a. Contains national statistics data © Crown copyright and database right [2017]. Contains OS data © Crown copyright [and database right] (2017))

its residents. The City Council lifts these out as key policy objectives in the Sustainable Community Strategy 2010–2020: "…despite the underlying strength of Nottingham's economy, too many people in the city remain disconnected from the jobs, wealth and opportunities. Poverty persists in many communities, side by side with prosperity" (NCC 2009).

In terms of household income, average (mean) earnings in the City of Nottingham are £7800 per annum lower compared with the English average, although it should be noted that London wages tend to skew the national averages (Table 12.1). The map of average incomes at MSOA level reveals that most of the higher earners are on the one hand concentrated in just a few wealthy areas within the city boundary and, on the other, they mostly live outside of the city boundary in the surrounding districts, especially in Rushcliffe to the south of the city (Fig. 12.2). Data on earnings by residence and by workplace shows that the average earnings of people who live in the city of Nottingham is £4400 per annum lower than of those who commute to work in the city while residing elsewhere (Table 12.1).

Table 12.2 Child poverty in Greater Nottingham[a] as children in workless and low-income families, 2013–2014

	Children					
	Workless no.	Low-income no.	Total no.	Workless percent	Low-income percent	Total percent
Nottingham City	**21,300**	**20,700**	**42,000**	**32.9**	**31.9**	**64.8**
Broxtowe	3200	4100	7300	15.2	19.5	34.7
Gedling	3700	5200	8900	16.0	22.5	38.5
Rushcliffe	1700	3200	4900	7.5	14.1	21.6
East Midlands	178,000	234,400	412,400	18.1	23.9	42.0
England	2,220,300	2,735,900	4,956,200	19.1	23.5	42.5

Data: *HMRC Child and Working Tax Credit Statistics, Finalised Awards 2013/14*
Source: NCC 2015
[a]Excludes Hucknall

Child Poverty

The patterns of deprivation discussed above have specific impacts on children in the city of Nottingham. Children are considered in this case study to provide a perspective on intergenerational justice, as this research does not project into future conditions. The levels of poverty associated with the city affect more children than the English average, and the child poverty rates of Nottingham, compared with the surrounding districts, are two or even threefold compared with neighboring Rushcliffe (Table 12.2). The City authorities (NCC 2015) analyze child poverty via two measures: poverty due to family worklessness and that due to low income. Again, the lack of detailed household income data means that the city authorities have estimated these figures using working tax credit data as a proxy for incomes. Child poverty due to worklessness is particularly high in the city of Nottingham, compared with the neighboring districts.

Educational Attainment

Apart from child poverty, educational attainment is a key policy concern for the city—the social divide observed in the income and deprivation maps is reflected starkly in educational attainment across Greater Nottingham. The educational attainment in the city of Nottingham is among the lowest of all English local authority areas, according to national figures published by the

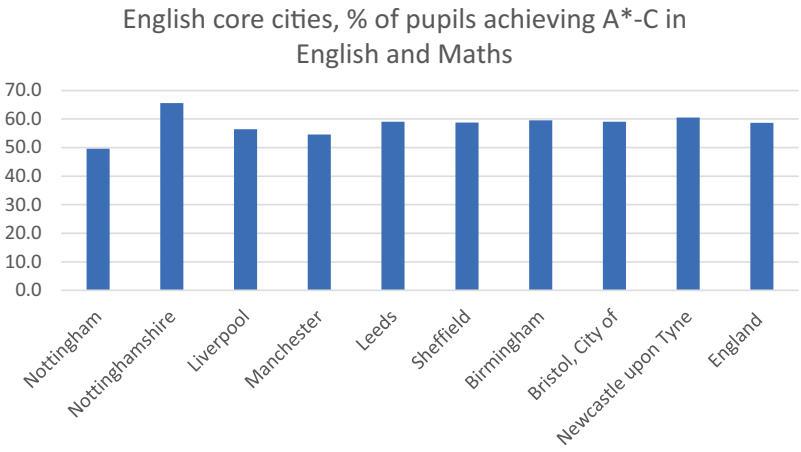


Fig. 12.3 Educational attainment in English core cities, pupil percentage achieving A*–C in English and Math (Data source: DfE 2016)

Department for Education (DfE) (DfE 2016). Compared with other English core cities, Fig. 12.3 shows that Nottingham is the only one of the English core cities group[1] with fewer than 50 percent of pupils achieving the grades A*–C in English and Math. By contrast, the surrounding Nottinghamshire county has an average score of 65.6 percent, well above the English average of 58.7 percent (DfE 2016). Considered together, child poverty, multiple deprivation, and educational attainment data bring forward questions of spatial and intergenerational justice for the children who live in the city of Nottingham.

Housing and Urban Morphology

The geographic pattern of deprivation and disadvantage is well established in Greater Nottingham. The city of Nottingham's relationship with its neighboring districts, Broxtowe, Gedling, and Rushcliffe, demonstrates how most of the poverty and disadvantage in Greater Nottingham is concentrated within the city boundary. It has also emerged from the case study that this pattern makes Greater Nottingham among more spatially divided urban areas in England. The reasons behind this spatial pattern are complex but the history and trajectory of the housing market as well as the definition of local authority boundaries are explaining factors. Nottingham's urban morphology reveals a tight administrative boundary around the City of Nottingham. This impacts on all statistics associated with the city. Large public housing estates within

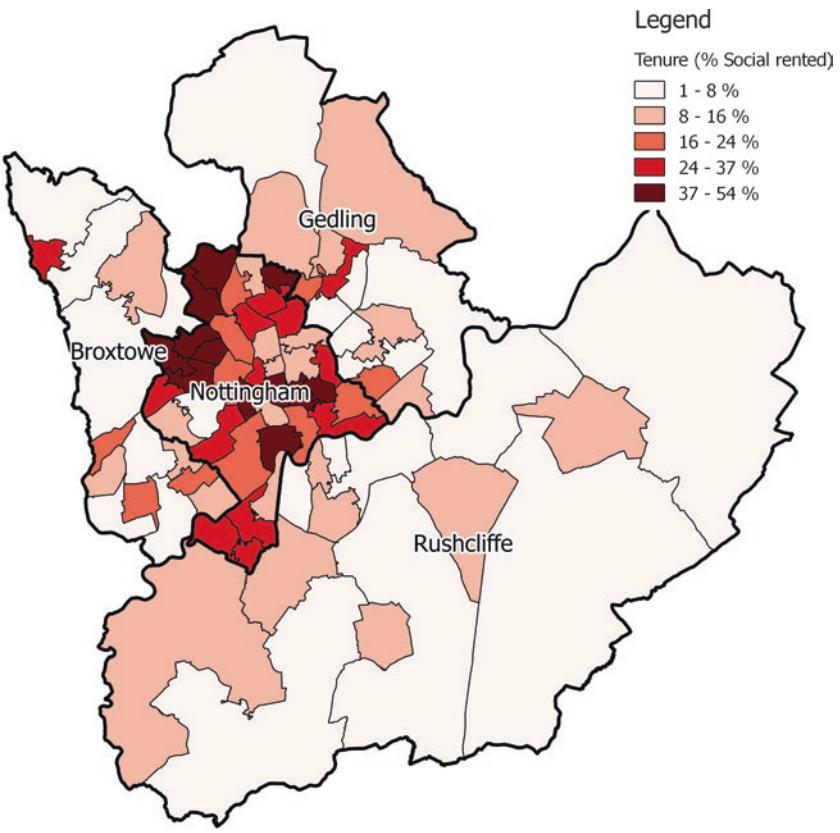


Fig. 12.4 Public housing as a percentage of housing stock in Greater Nottingham by MSOA (Data Source: 2011 Census, ONS 2016b. Contains National Statistics data © Crown copyright and database right [2017]. Contains OS data © Crown copyright [and database right] (2017))

the city boundary have a similar effect. Figure 12.4 details the concentration of public housing as a percentage of all dwelling stock at the MSOA level, showing a close relationship with Figs. 12.1 and 12.2 tracing multiple deprivation and average incomes in the city region. The concentration of public housing stock is part of the city's social history (Smith and Whysall 1990). Nottingham boasted internationally renowned public housing schemes in the interwar period where significant council housing estates were built for the city's workers, owing to the political will and leadership in the city at the time (Broxholme 2013). Political and economic change from the 1980s onward in the UK meant that housing policies led to a social and economic residualization of public housing estates (Murie 1997; Pawson 2006); the levels of depri-

vation in social housing today are in part a legacy of Thatcherite social and economic reforms and symptomatic of the unfinished economic restructuring of northern cities in England.

Lessons Learned

The Nottingham case highlights the tensions that exist in urban sustainable development. Nottingham City has excelled in the environmental dimension of sustainability; meanwhile, it has struggled to address the long-standing social concerns associated with poverty, inequality, and deprivation, although the City Council's sustainability policies clearly state reducing poverty and inequality among its core aims. The spatial dimension of inequality is clearly expressed in the Greater Nottingham geography. Nottingham's relationship with its suburban neighbors is defined by most of the disadvantage being found in the city, while the city also offers well-paid job opportunities for the suburban commuters. The concentration of low income and worklessness in the city is partially explained by the provision of public housing within the city itself. This pattern of housing is a historic legacy from the heyday of local government house building schemes in Nottingham, when the city received international attention as an exemplar public housing builder. It is much later that public housing became residualized through political and economic changes in the UK, from 1980s onward.

The city's style of governance and leadership have enabled advances to be made within the city's environmental strategy, propelled forward by successful external funding to enable delivery. However, from a socio-economic perspective, Nottingham's residents face significant inequalities within the urban area as well as in the national context in overall deprivation, household income, educational attainment, and life expectancy. The children who live in the city are disadvantaged compared with their peers in Greater Nottingham and England. These inequalities may partly explain why more affluent families move out of the city and also graduates from Nottingham's two universities are more likely than in other English university towns to leave the city after qualifying. Nottingham's urban morphology in terms of public housing stock concentrations and a tight administrative boundary certainly influence these statistics.

In terms of urban sustainability initiatives, there seems to be more agency at the local level to tackle environmental policy objectives compared with social policy. The main tool to address income inequality is welfare redistribution; however, social security policy is determined by the national UK government.

The national government retains power over issues such as taxation, redistribution, as well as local government finance. English local government is wholly dependent on central government for its core funding allocation. In recent years, urban areas with high levels of poverty have been significantly affected by national austerity-related cuts to local government funding, as well as the cuts to social security payments to residents. Nottingham City Council's own analysis suggests the government funding it receives to deliver public services has been cut by half in real terms after the general election of 2010. This may be one contributing factor to the continued problems associated with poverty and inequality in the city, although deprivation is a long-standing issue in Nottingham and the patterns observed here were established prior to the present squeeze on local government resources.

Challenges and Barriers

Governance appears to have made a difference in urban sustainability in Nottingham, both as an enabler and a barrier. On the one hand, urban governance with the city's ownership of assets such as public housing, district heating networks, the energy retailer, and its significant stake in the local public transport provision have enabled major low-carbon schemes in Nottingham. On the other hand, the style of welfare state governance in the UK renders many important variables outside of the control of local government, including taxation, redistribution, and social security which are relevant in the context of socio-economic inequality or in the words of urban social sustainability literature, improvements in the quality of life for all and a just distribution of the burdens from urbanization, which includes economic restructuring. An alternative interpretation of the success of Nottingham's environmental schemes over social progress is that there may be more incentives and funding for cities to tackle the scientifically and politically dominant objective of climate change, as opposed to socio-economic inequality where the hegemonic discourse still believes in the "invisible hand of the market" delivering individual rewards fairly.

The Nottingham case also points to the residualization of public housing estates in England which stem from national policy. Nottingham's urban morphology presents further challenges for the city, a tight boundary which contains much of the conurbation's public housing but also higher-value jobs. One possible route to address the boundary challenge is closer cooperation or formal amalgamation with the neighboring authorities—such as the devolution deal encouraged by the UK government that comes with extra resources (Department for Communities

and Local Government 2017). This model is deployed in some English city regions outside of London, Manchester being the first, where certain powers are coordinated at metropolitan level via a new combined authority with a directly elected city region mayor, following the London model. A case study of the Liverpool city region mayoral model suggests that there is limited empirical evidence of improved urban outcomes from this type of governance (Headlam and Hepburn 2017). Changing boundaries may statistically improve Nottingham's position, and there might be added benefits of coordination in some policy topics over the metropolitan area, but it does not address the underlying reasons of inequality. If national policy remains unchanged, the scope is limited in terms of what can be achieved at the local level about income inequalities and the related social burdens.

Finally, if urban social sustainability is understood via human rights which includes equitable access to services, social sustainability is becoming increasingly challenging for cities, as their capacity as a service deliverer is eroded by cuts to local government funding. Most of the social inequalities reviewed here, including educational attainment and life expectancy, are not perhaps directly caused by low income, but they are certainly closely linked to poverty and inequality, and much of this is the bread and butter of public services that local government delivers within the resources it has. A major academic study into local government cuts concluded that the way in which the UK government has implemented the cuts to local government funding impacts more heavily on areas with the poorest residents (Hastings et al. 2013). Nottingham hosts some of the most deprived communities in England; thus they will be further disadvantaged by austerity. In terms of the impact of these cuts more widely, Hastings et al. (2013) conclude that local government will have a diminished role in terms of providing for well-being and quality of life:

> *The scale of the reductions in the spending power of English and Scottish local authorities suggests that a massive change is underway with respect to the centrality of local government services related to well-being and quality of life. Local government 's share of the economy is set to fall from over 5 percent in 2008/9 to 3.6 percent in 2014/15.* (Hastings et al. 2013, 17)

Looking across the Atlantic, the picture from US cities is even bleaker where city governments have faced bankruptcy: "the Wall Street crisis has duly become a state and local government crisis in the USA, driving an unprecedented wave of service and staffing cuts, along with new rounds of institutional transformation executed at the cusp of fiscal default" (Peck 2014, 17).

The politics of austerity have become the default fiscal position of many national governments in Europe as well as the USA. This has had a major impact on cities and undoubtedly on the quality of life of urban residents. This case study did not study the impact of urban austerity on different socio-economic groups, but it is reasonable to hypothesize that poorest communities will experience greater impacts; therefore, austerity may widen existing inequalities in cities. This is a sustainability challenge that should be brought to the forefront of urban sustainability debates on a par with concerns about the changing climate.

Acknowledgments The author would like to thank Dr. Gavin Long, University of Nottingham, who created the maps used in this case study. The research for this chapter was enabled by funding from the Leverhulme Trust, under the research program grant Sustaining Urban Habitats—An Interdisciplinary Approach.

Note

1. A group of ten UK cities outside of London, often used in policy comparison and collaboration, see https://www.corecities.com/about-us. The education data used in the case study only refers to eight English core cities; Cardiff and Glasgow are within the devolved administrations of Wales and Scotland.

Further Reading

Cook, I.R., and E. Swyngedouw. 2012. Cities, Social Cohesion and the Environment: Towards a Future Research Agenda. *Urban Studies* 49 (9): 1959–1979.

Holifield, R., M. Porter, and G. Walker. 2009. Introduction Spaces of Environmental Justice: Frameworks for Critical Engagement. *Antipode* 41 (4): 591–612.

Imrie, R., and L. Loretta, eds. 2014. *Sustainable London?: The Future of a Global City*. Bristol: Policy Press.

Peck, J. 2014. Pushing Austerity: State Failure, Municipal Bankruptcy and the Crises of Fiscal Federalism in the USA. *Cambridge Journal of Regions, Economy and Society* 7 (1): 17–44.

Soja, E. 2010. *Seeking Spatial Justice*. Minneapolis: University of Minneapolis Press.

Swyngedouw, E., and M. Kaika. 2014. Urban Political Ecology. Great Promises, Deadlock… and New Beginnings? *Documents d'Anàlisi Geogràfica* 60 (3): 459–481.

Wilkinson, R., and K. Pickett. 2014. A Convenient Truth. A Better Society for us and the Planet [online] Fabian Society. Available from http://www.fabians.org.uk/publications/a-convenient-truth/. Accessed 31 Aug 2017.

References

Blackstock, K. L., E. A. Kirk, and A. D. Reeves. 2005. Sociology, Science and Sustainability: Developing Relationships in Scotland. *Sociological Research Online*, 10(2) [online]. http://www.socresonline.org.uk/10/2/blackstock.html. Accessed 29 July 2017.

Bramley, G., and S. Power. 2009. Urban Form and Social Sustainability: The Role of Density and Housing Type. *Environment and Planning B: Planning and Design* 36 (1): 30–48.

Brandon, P., P. Lombardi, and G. Shen. 2017. *Future Challenges in Evaluating and Managing Sustainable Development*. Chichester: Wiley.

Broxholme, P. 2013. Back to the Future? The Tory Party, Paternalism, and Housing Policy in Nottingham 1919–1932. *Midland History* 38 (1): 99–118.

Centre for Cities. 2015. Cities Outlook 2015. [online]. Available at: http://www.centreforcities.org/wp-content/uploads/2015/01/15-01-09-Cities-Outlook-2015.pdf. Accessed 28 Aug 2017.

Colantonio, A. 2010. Urban Social Sustainability Themes and Assessment Methods. *Proceedings of the ICE — Urban Design and Planning* 163 (2): 79–88.

Cole, L.W., and S.R. Foster. 2001. *From the Ground Up: Environmental Racism and the Rise of the Environmental Justice Movement*. New York: NYU Press.

Cuthill, M. 2010. Strengthening the "Social" in Sustainable Development: Developing a Conceptual Framework for Social Sustainability in a Rapid Urban Growth Region in Australia. *Sustainable Development* 18 (6): 362–373.

Daly, H. 1990. Toward Some Operational Principles of Sustainable Development. *Ecological Economics* 2 (1): 1–6.

Dave, S. 2011. Neighborhood Density and Social Sustainability in Cities of Developing Countries. *Sustainable Development* 19 (3): 189–205.

Dempsey, N., G. Bramley, S. Power, and C. Brown. 2011. The Social Dimension of Sustainable Development: Defining Urban Social Sustainability. *Sustainable Development* 19 (5): 289–300.

Department for Communities and Local Government. 2015. English Indices of Deprivation 2015 [online]. Available from: https://www.gov.uk/government/statistics/english-indices-of-deprivation-2015. Accessed 15 Aug 2017.

———. 2017. Devolution and Mayors: What Does it Mean? [online]. Available from: https://www.gov.uk/government/publications/devolution-and-mayors-what-does-it-mean. Accessed 30 Aug 2017.

Department for Education. 2016. SFR48/2016: GCSE and Equivalent Results in England 2015/16 (Provisional). online. Available from https://www.gov.uk/government/statistics/gcse-and-equivalent-results-2015-to-2016-provisional.

Economist. 2015. How Inequality Affects Growth. *The Economist* [online], 15 June. Available from: https://www.economist.com/blogs/economist-explains/2015/06/economist-explains-11. Accessed 29 July 2017.

Ginsburg, N. 2005. The Privatization of Council Housing. *Critical Social Policy* 25 (1): 115–135.

Griggs, D., M. Stafford-Smith, O. Graffney, J. Rockstrom, M.C. Öhman, P. Shyamsundar, W. Steffen, G. Glaser, N. Kanie, and I. Noble. 2013. Policy: Sustainable Development Goals for People and Planet. *Nature* 495: 305–307.

Hastings, A., N. Bailey, K. Besemer, G. Bramley, M. Gannon and D. Watkins 2013. Coping with the Cuts? Local Government and Poorer Communities [online]. Available from http://www.soft-tissue-research.org/media/media_296671_en.pdf. Accessed 30 Aug 2017.

Haughton, G. 1999. Environmental Justice and the Sustainable City. *Journal of Planning Education and Research* 18 (3): 233–243.

Headlam, N., and P. Hepburn. 2017. What a Difference a Mayor Makes. A Case Study of the Liverpool Mayoral model. *Local Government Studies* 43: 1–21.

Lawton, C., and N. Blackley.. 2016. The Great Nottingham Debate 2016 [pdf]. Nottingham Trent University. Available from https://www4.ntu.ac.uk/news_events/document_uploads/185955.pdf. Accessed 29 Aug 2017.

Lefebvre, H. 1968. *Le droit à la ville*. Paris: Anthropos.

Lehtonen, M. 2011. Social Sustainability of the Brazilian Bioethanol: Power Relations in a Centre-Periphery Perspective. *Biomass and Bioenergy* 35 (6): 2425–2434.

Lidskog, R., A.P.J. Mol, and P. Oosterveer. 2014. Towards a Global Environmental Sociology? Legacies, Trends and Future Directions. *Current Sociology* 63 (3): 339–368.

Maloutas, T. 2003. Promoting Social Sustainability The Case of Athens. *City* 7 (2): 167–181.

Merrifield, A., and E. Swyngedouw, eds. 1996. *The Urbanization of Injustice*. London: Lawrence & Wishart.

Murie, A. 1997. The Social Rented Sector, Housing and the Welfare State in the UK. *Housing Studies* 12 (4): 437–461.

Murphy, K. 2012. The Social Pillar of Sustainable Development: A Literature Review and Framework for Policy Analysis. Sustainability: Science, Practice & Policy, 8 (1) [online]. Available at: https://sspp.proquest.com/the-social-pillar-of-sustainable-development-a-literature-review-and-framework-for-policy-analysis-2bec2d6c051. Accessed 31 Aug 2017.

Musterd, S. 2005. Social and Ethnic Segregation in Europe: Levels, Causes, and Effects. *Journal of Urban Affairs* 27 (3): 331–348.

Nottingham City Council. 2009. Sustainable Community Strategy 2020 [online]. Nottingham City Council. Available from http://www.onenottingham.org.uk/wp-content/uploads/2016/08/SCS_Final.pdf. Accessed 30 Aug 2017.

———. 2015. Child Poverty in Nottingham 2015 [online] Nottingham Insight. http://www.nottinghaminsight.org.uk/themes/deprivation-and-poverty/child-poverty/. Accessed 30 Aug 2017.

———. 2017a. Population – Headline Statistics [online]. *Nottingham Insight*. Available from https://www.nottinghaminsight.org.uk/people/population/. Accessed 30 Aug 2017.

———. 2017b. EU Accession note (June 2017) [online] *Nottingham Insight*. Available from http://www.nottinghaminsight.org.uk/Libraries/Document-Library/63501. Accessed 30 Aug 2017.

———. 2017c. Go Ultra Low Nottingham. [online] Nottingham City Council. Available from http://goultralownottingham.org.uk/about-nottingham/. Accessed 30 August 2017.

Nottingham City Joint Needs Assessment. 2013. Life Expectancy [online] Nottingham City Council. Available from http://jsna.nottinghamcity.gov.uk/insight/Strategic-Framework/Nottingham-JSNA.aspx. Accessed 30 Aug 2017.

Office of National Statistics (ONS). 2011. 2011 Census: Boundary Data (England and Wales) [online]. Downloaded from: https://borders.ukdataservice.ac.uk/. Accessed 17 Aug 2017.

———. 2016a. Small Area Model-Based Income Estimates, England and Wales: Financial Year Ending 2014 [online]. Available through: https://www.ons.gov.uk/peoplepopulationandcommunity/personalandhouseholdfinances/incomeandwealth/articles/smallareamodelbasedincomeestimatesenglandandwales/financialyearending2014. Accessed 30 Aug 2017.

———. 2016b. 2011 Census Aggregate Data. UK Data Service (Edition: June 2016) [online]. Available through: https://www.nomisweb.co.uk/. Accessed 17 Aug 2017.

Pawson, H. 2006. Restructuring England's Social Housing Sector Since 1989: Undermining or Underpinning the Fundamentals of Public Housing? *Housing Studies* 21 (5): 767–783.

Polèse, M., and R.E. Stren. 2000. *The Social Sustainability of Cities: Diversity and the Management of Change*. Toronto: University of Toronto Press.

Purcell, M. 2014. Possible Worlds: Henri Lefebvre and the Right to the City. *Journal of Urban Affairs* 36 (1): 141–154.

Sharzar, M., A. Ianakiev, and A. Stacey. 2017. Smart Cities Case Study – The Nottingham Experience. In *Future Challenges in Evaluating and Managing Sustainable Development in the Built Environment*, ed. P. Brandon, P. Lombardi, and G. Shen. Wiley-Blackwell: Hoboken.

Smith, R., and P. Whysall. 1990. The Addison Act and the Local Authority Response: Housing Policy Formulation and Implementation in Nottingham 1917–1922. *Town Planning Review* 61 (2): 185.

Soja, E., and M. Kanai. 2014. The Urbanization of the World. In *Implosions/exlosions – Towards a Study of Planetary Urbanization*, ed. N. Brenner. Berlin: Jovis Verlag.

Tammaru, T., S. Marcińczak, M. van Ham, and S. Musterd, eds. 2016. *Socio-Economic Segregation in European Capital Cities*. London: Routledge.

UK Data Service. n.d. SN:5819 UKBORDERS: Digitised Boundary Data, 1840- and Postcode Directories, 1980-. http://discover.ukdataservice.ac.uk/catalogue/?sn=5819&type=Data%20catalogue, Retrieved from http://census.ukdataservice.ac.uk/get-data/boundary-data.aspx. Contains public sector information licensed under the Open Government Licence v3.

Vallance, S., H.C. Perkins, and J.E. Dixon. 2011. What is Social Sustainability? A Clarification of Concepts. *Geoforum Themed Issue: Subaltern Geopolitics* 42 (3): 342–348.

13

Methods for Integrated Sustainability Assessment: The Case of Small Holder Farming in Karnataka, South India

Sheetal Patil and Seema Purushothaman

Background

The number of operational land holdings in India, according to Agricultural Census 2010–11, has increased from 51 million in 1961–62 to 138 million in 2010. However, the area operated has not kept pace with 133 million hectares in 1960–61 increasing only to 159 million hectares in 2010. Thus, the overall average landholding size declined from 2.63 hectares in 1960–61 to 1.15 hectares in 2010. Notable in this period is the dramatic threefold increase in the number of and area under small and marginal landholdings, without any change in the average size of such holdings. In 1971, average size of marginal holding was 0.48 hectares and in 2010–11, it decreased marginally to 0.40 hectares, whereas small holders' average size remained unchanged from 1.44 hectares in 1971–72 to 1.42 hectares in 2010–11. As of 2010–11 census, around 85 percent of landholdings of the small and marginal category operate 46 percent of total cultivated area. With just 46 percent of land area under small and marginal holders, their share in the total crop output is almost half that of the entire nation. Notably, 91 percent of the land under the small and marginal holdings is cultivated with food crops (Agricultural Census 2010). Even with respect to high-value crops, small and marginal farms contribute a significant share: 70 percent of the total vegetable production, 55 percent of the total fruit pro-

S. Patil (✉) • S. Purushothaman
School of Development, Azim Premji University, Bangalore, Karnataka, India

R. Brinkmann, S. J. Garren (eds.), *The Palgrave Handbook of Sustainability*,
https://doi.org/10.1007/978-3-319-71389-2_13

duction, and 69 percent of the milk production come from them (Dev 2012). Thus, small and marginal farmers contribute to both crop diversity and food security while representing the social and cultural diversity of Indian society.

Hence it is important to sustain small holders in order to meet the national goals of food security and poverty reduction. But this envisages appropriate policies and institutions, to ensure access to infrastructure, technology, credit, market, insurance, and so on. Effective institutions and policies for easing distress through welfare schemes for affordable food, education, and health services are also important. Another aspect, often ignored, is their need for access to sufficient quantity and quality of ecosystem functions—soil, water, biodiversity and biomass. Such policies to encourage sustainable farming practices are found in small pockets of the country, but they need to compete with widely popular subsidy-based schemes for synthetic inputs. Purushothaman et al. (2013) report the role of inclusive design and participatory governance along with effective implementation of natural resource management schemes for small holders. A governance approach integrating the above needs of small holders might impart some hope to small farmers in India. This chapter focuses on assessing such an attempt by the state government of Karnataka in Southern India.

The next section briefs the threats and challenges in small-scale agroecological farming, followed by a discription of what could be the governance support needed for management and its impacts. Using the case of a recent policy introduced in the state of Karnataka, South India, the following section presents an integrated impact assessment method for sustainability of small farms. The penultimate section discusses the results before we present the lessons learnt on methodological and contextual issues in assessing the effectiveness of governance mechanisms for sustainable farming among smallholders.

Small and Marginal Holders in India

During the 1960s, with increase in yield of certain crops, India almost turned self-sufficient in food grain production (Bhattacharya and Chakraborty 2005). This was accomplished by making the small farmer more dependent on external forces. The high dependence on external inputs increased risk and had environmental and social fallouts (Deshpande 2002).[1] Yet, even as the National Agricultural Policy remains locked in the Green Revolution paradigm (Jha 2003). Since 1990s Indian agriculture is

characterized by stagnating yields (IES 2010), low productivity, adverse climatic conditions (Abraham 2009), declining contribution to GDP (IES 2010), degradation of land and water resources (Singh 2009), and low returns. To make matters worse for the small holder, there also has been a decline in public investment in irrigation water management, and scientific research (Bhalla and Singh 2009). At the same time, though agricultural subsidies have been on the rise, they have not necessarily improved the economic condition of Indian farmers (see Acharya and Jogi 2004). This paradox—high public expenditure for agriculture and rural development coexisting with rural distress—is reflected in by low development indicators for rural areas (Human Development Report 2016).

There is both an *agrarian* as well as *agricultural* crisis in India. The agrarian crisis is seen in growing marginalization in terms of failed support systems, while agricultural crisis is seen in problematic access to inputs and profit realization (Reddy and Mishra 2009). The most tragic fallout of the crises is unabated incidence of farmer suicides. On an average, there have been 12,000 farmer suicides in India every year since 2013 (NCRB 2014).

While the dominant presence of small farmers could in fact be a solution to the ongoing crisis in food (Rajivlochan 2008), and nutritional security of the society, they are now considered unviable. This is seen in mainstream policy discussions that refer to the small and marginal farms as "unviable" (PIB[2] 2008), and suggest that they should sell or lease out their land and move to urban areas (see also Gulati et al. 2008). However, there seems to be insufficient attention to see if this migration has succeeded in transforming the life of rural poor or just turned them to urban poor. The gains from the Green Revolution have been significantly realized by large landholders (Rao 1975 cited in Reddy and Mishra 2009, 14) and irrigated agriculture (Reddy 2011). Reddy and Mishra (2009) have raised concern about the economic viability of small and marginal farmers despite acknowledgement about the inverse relationship between farm size and productivity (Chand et al. 2011). It is still believed that large-scale, mechanized farms are more efficient than the small family farms (Ellis and Biggs 2001).

Irrespective of the land size, agricultural sustainability would refer to production practices that are environmentally non-damaging, financially viable, and socially desirable. This is the biggest challenge to farming community in the present time all around the globe. Key principles of agricultural sustainability according to Pretty et al. (2008) are to (1) integrate biological and ecological processes such as nutrient cycling, nitrogen fixation, soil regeneration, and so on into food production processes; (2) minimize the use of those

nonrenewable and toxic inputs; (3) make productive use of the knowledge and skills of farmers, farm workers, and advisors; (4) make productive use of people's collective capacities to work together to solve common agricultural and natural resource problems; and (5) be economically sustainable. Thus, sustainability of any given agricultural system is not precisely measurable, especially because external factors such as labor and water crunch, adverse climate and price fluctuations are very difficult to measure (Pretty 1995). The most popular and common attempt of sustainability assessment is the three-pronged concept with the triple baselines of "economy," "environment," and "society" (e.g. Lozano 2008, Cai and Smith 1994; Hansen 1996; Rigby and Caceres 2001; Von Wirén-Lehr 2001). Complexity of the concept and immeasurability leads to lack of attention toward it and hence lack of clarity on sustaining small-scale farmers.

Case Study: Sustainability in Small and Marginal Farms of Karnataka

Karnataka, a southwestern state of India, shows similar trend to that of the country in general in that its fast-growing economy (14 percent in 2014–15) is not reflected in its agricultural growth rates (for instance, agricultural share in GDP decreased from 28 percent in 1995 to 18 percent in 2014, while the annual average growth in GSDP was 14.78 percent). About 55.5 percent of workers in Karnataka are classified as cultivators and agricultural laborers (NABARD). The state is also home to notable share of agrarian distress (Purushothaman and Kashyap 2010). Farmers' suicids in the state is one of the highest in the country with 35,053 suicides reported between 1995 and 2010 (National Crime Records Bureau 1995–2010). While suicides are acknowledged as only the tip of the iceberg of distress (Reddy and Mishra 2009, 111), the sector is constrained by many other aspects—large extent of rain-fed land (irrigation only in 30 percent of cultivated area), low value, low-yield cropping pattern, and a large share of dependent population. Technology focus on dry or rain-fed areas (Deshpande 2008) leaves a lot to be desired. Over 60 percent of farmer households in Karnataka were indebted, a figure which has doubled since 1991 (Narayanamoorthy and Kalamkar 2005). Traditional crop varieties and cropping practices, such as mixed farming, crop rotation, and intercropping, are gradually disappearing. The percentage of small and marginal holdings in the state is now 75 percent (Agricultural Census 2010).

The popular seed-fertilizer approach to productivity growth with inadequate emphasis on organic amendments has led to depletion of soil fertility in many parts of the state (Deshpande in Reddy and Mishra 2009, 206). Table 13.1 characterizes both the state vis-a-vis the country with respect to economy, crop yield, farm returns, and land degradation (Fig. 13.1).

Both at national level and in the state, there have been policies targeting small holders. Some of them are specific to the primary sector and others integrated with various sectors involved in rural development. Most of these policies like technology missions, support pricing, and small credit significantly involve the state Department of Agriculture (with some support from the central government at times). Some other policies like those on land tenure, land reforms, and land acquisition are implemented by other departments, with a strong thrust from the central government.

Among the new genre of policies are those pertaining to sustainable agriculture. Among them is the Karnataka State Policy on Organic Farming (KSPoOF) formulated in 2004. The sustainability goals of KSPoOF include maintaining and improving the natural environment, economic viability, and social acceptance (GoK 2006). The policy aimed at reducing the burden of debt on small farmers without compromising on the economic and social conditions, by encouraging in situ generation of inputs. The policy also triggered other similar investments by the state government toward sustainable agriculture.

The policy implementation happened in phases in the state beginning from 2004. Initially, one village in each district was selected based on certain criteria, such as available natural resources and livestock for manure and inputs. Willingness of farmers to shift to another farming practice along

Table 13.1 Karnataka—relevant features

Comparative characteristics	Karnataka	India
Economic growth rate (2015–16)	6.2	7.9
Agriculture share in GDP (2014–15)	13.4	17.9
Farmer suicide (in 2015)	1569 (4th rank)	12609
Land degradation (%)	40 (SoER report 2003)	57 (MoEF 2001)
Small and marginal holders (%) (2010–11)	76.4	85
Net irrigated area (%) (2013–14)	35.56	66.1
Fertilizer use (kg/ha) (2014–15)	156	128.1
Food crop yields (kg/ha) (2014–15)	1847	2011
Oilseed yield (kg/ha) (2014–15)	735	1126
Cotton yield (bales/ha) (2014–15)	735	480
Sugarcane yield (ton/ha) (2014–15)	395	70
Persons below poverty line (%) (2011–12)	20.9	21.9

Fig. 13.1 Small patches of farmlands between two stretches of common lands (grassland and hillock)

with availability of farmland was also considered. In each selected village, a local nongovernmental organization (NGO) was identified for training and guiding farmers in the process of converting conventional agricultural practices to organic farming. Slowly, the policy was implemented for one village in each taluk (sub-district level). Here, too the same procedure was adopted for selection of villages and NGO. Our study aimed at assessing the impact of two strikingly opposite policies (KSPoOF and policies that promote subsidized chemical inputs) and governance structures for sustainable use of natural resources in small and marginal farms in Karnataka.

Methodology

Keeping in mind the multi-functionality of the agrarian landscape, we intended to develop a framework of land use functions (LUFs). The LUFs and associated indicators were finalized in consultation with academic experts in the domain, farmers, and other stakeholders including voluntary agencies. In order to reflect the diversity in agraricultural contexts of the state, the study was situated in five different agroclimatic zones—northern dry, eastern dry, central dry, southern transitional, and coastal zones (Figs. 13.2 and 13.3).

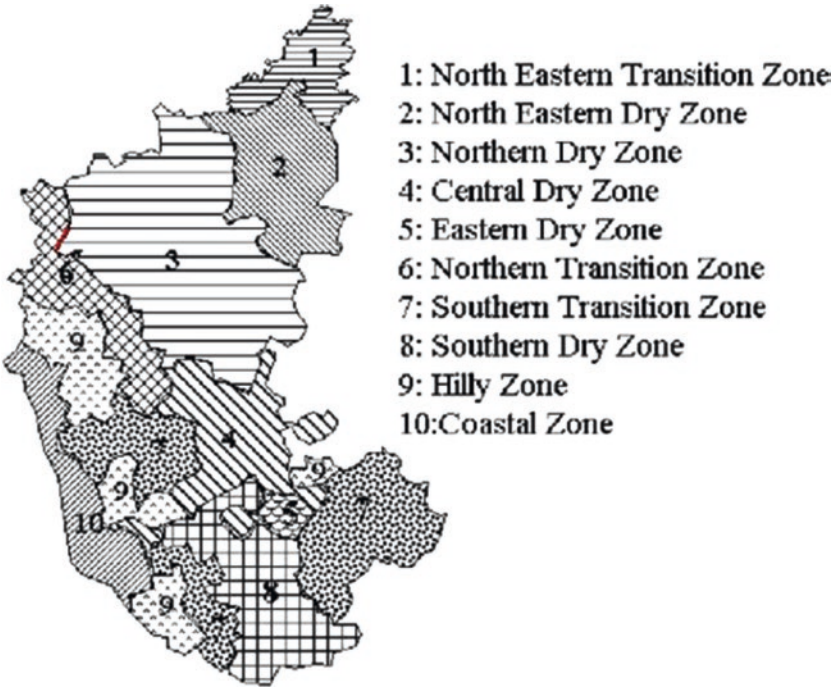


Fig. 13.2 Agroclimatic zones in Karnataka

Fig. 13.3 Farm yard manure ready to be spread in a paddy field

While detailed socioeconomic interviews with households were conducted to gather data on various farming activities and outcomes, for more qualitative information like collective perceptions about farming practices and preferred land use functions, focus group discussions were used. In order to assess and compare the sustainability potential of different practices, we needed to build different scenarios, taking into account various parameters that impact the sector. Scenario options for sustainability assessment were also discussed among stakeholders such as policy makers and scientific and technical experts. This assessment depended upon consensus regarding three policy-driven farming scenarios, envisaging future trends in the selected indicator values. Consensus was drawn keeping in mind the prevalent chemical input-based farming practices and two other alternatives available, namely, using both the synthetic and organic inputs and only organic inputs.

The scenarios were named as: S1, "With policy (WP)" when farming practices confined to exclusive use of organic inputs; S2, "Business as usual (BAU)" with conventional input (external) intensive farming practices; and S3, "Mixed practices (MP)" including use of both organic and synthetic inputs.

These constituted the ideal or typical initial steps of site selection, indicator framework (based on LUF), and scenario building within the policy impact assessment. Then the biggest question was which method would be the most appropriate in such a policy impact analysis. As the research question which centered on conducive policy environments in multifunctional land use regions with multi-stakeholder, natural resource-based traditional livelihood activity was not amenable to be studied using a single best method, we decided to use a number of carefully selected methods. This decision was based on the realization that among the suitable methods, each one had its strengths and weaknesses and what is suitable for one question may not be suitable to answer another question.

Each method had a different objective and hence followed a different process. Table 13.2 details the purposes of each method used. The assessment process started with analysis of the problem and moved on through selection of study sites, and collection of data, followed by the sequential application of various methods. Thus, all selected methods looked at three criteria—socio-cultural, economic, and ecological, while specific ones like the bio-physical model and governance analysis could omit one of these criteria. This plural approach ensured a useful mixture of qualitative and

Table 13.2 Analytical tools and purpose

Tools	Type	Purpose/to find	Scenarios compared
Causal Chain Analysis	Quantitative	Causalities of spatial and temporal variations	–
Participatory Impact Assessment (PIA)	Qualitative	Collective assessment of potential scenarios, and their impacts on indicators	S1, S2, S3
Bio-physical model (TechnoGIN)	Quantitative	Input-output coefficients for different cropping patterns and rotations in two farming practices	S1 and S3
Multi-criteria Analysis	Quant-Qual	Pros and cons of different policies with respect to SD	S1 and S3
Simultaneous Equations Model	Quantitative	Solve concurrent set of variations in factors affecting SD for projections	S1 and S3
Governance Analysis	Qualitative	Socio-cultural and institutional drivers of policy outcomes	–

quantitative tools. Each method involved comparative assessment of two or more scenarios (Table 13.2).

In the following subsections, these methods are discussed briefly followed by major findings emerging from each.

Participatory Impact Assessment (PIA)

Participatory processes are now growing in popularity and many governments now turn to participatory approaches to develop practical solutions to various problems within agriculture (Bruges and Smith 2008). One of the perceived risks in closely involving various stakeholders, may be a fear of loss of scientific depth and authority (Bouma 1997). We conducted five PIAs modifying and adapting the method used (Morris et al. 2011) to the study context. During these participatory workshops, participants ranked LUFs in the order of their preference and projected the impact of different practice-policy scenarios on all selected indicators of the corresponding LUF (see Purushothaman et al. 2012a for a detailed treatment of the PIA process adopted). Among nine indicators, health of the family members and access to water were overall ranked as the most important functions of farme land, while financial services received the lowest rank. Organic farming practices were projected to be the most beneficial for these functions during the impact scoring exercise in these workshops.

Bio-physical Modeling

Bio-physical sustainability of selected farm households in terms of their input use efficiency was estimated using TechnoGIN (TCG). TechnoGIN calculates technical coefficients such as monthly water and labor requirements; requirement of nitrogen, phosphorous, and potassium (NPK) fertilizers; nitrogen loss by leaching and volatilization; nutrient balance in the soil; biocide index; costs of production for different crops; and financial returns.

The results revealed that organic farming can potentially increase net returns, reduce risk of crop failure, and reduce environmental impacts (for details of bio-economic modeling in parts of this study, see Patil et al. 2012). Nevertheless, the advantages are bound to be site dependent. In the absence of sufficient organic fertilizers in the drier regions, organic practices may result in depletion of soil nutrients leading to yield loss in the long run. However, in wetter regions, where nutrient balances are highly positive, economic advantages are much better and more certain with organic practices compared to conventional practices.

Multi-criteria Analysis

Given the varied impacts of conventional practices, multi-criteria analysis (MCA) helped to understand the pros and cons of different policy-driven practices. The results indicate that continuation of policies favoring organic practices will help small and rain-fed farms to be sustainable through their reduced impacts on ecological, economic, and socio-cultural functions of land use. The results also revealed the potential of policies favoring organic practices in resource-poor areas (see Purushothaman et al. 2012b for details), than in agriculturally favorable areas.

Simultaneous Equations Model (SEM)

Adapting the approach from Fan et al. (2008) to this study, we used a multi-equation system. This was an attempt made to assess the simultaneous effect of three sustainability criteria (economic, ecological, and socio-cultural) on each other. A comparative statics analysis using a simultaneous equations model was accomplished to capture the stability of each sustainability criterion into the future and their concurrent interactive impacts and trade-offs (for details, see Purushothaman et al. 2012c). SEM reveals significant and positive impact of farming with organic inputs on ecological and economic indicators. However,

impact on socio-cultural indicators was dependent on site-specific social characteristics (e.g. caste, food habits, etc.) rather than farm practices per se. Echoing the results of MCA, this model too revealed better prospects for small and rainfed farms. The benefits were shown more significant when the inputs were produced on-farm instead of procuring from the market.

Governance Analysis

Governance aspects for managing natural resources in small farms were analyzed using 42 focus group discussions in 14 villages, one each with farmers, government officials, and voluntary workers in each location. An integrated policy approach with many interlinked agencies working together toward common goals may result in an outcome of either success or an unintended conflicting situation. In such contexts of uncertain outcomes, efficacy of the executive arm of the government in spreading awareness among all the stakeholders came out as the most essential factor. At the same time, widespread implementation of a range of schematic components (e.g. incentives for purchase of livestock, vermi-compost pits, azhola cultivation, water conservation schemes, etc.) within the policy emerged also as crucial for positive outcomes. Governance analysis indicated that inclusive design and participative governance contribute significantly to natural resource management (NRM) in small farms (Purushothaman et al. 2013).

Results and Discussion

The study was conducted in five different agroclimatic zones of the state of Karnataka and the results were mostly region specific. Results from the plural approach adopted in the study were mixed across study sites both in sustainability assessment of farming practices and in the needed governance support to foster NRM among small holdings. However, the results from all the methods were analogous for each region. Table 13.3 shows the results from quantitative methods like MCA, SEM, PIA, and the bio-physical model. For socio-cultural sustainability, the bio-physical model was not be considered as it doesn't take any of the social indicators into consideration. Table 13.3 presents the findings on performance of small farms with sustainable farming practices vis-à-vis conventional farming practices, in three categories.

The two quantitative methods (MCA and SEM), based on projected values of indicators corresponding to each LUF, furnished very similar results from all the five field sites. More importantly, both these methods revealed the absence of trade-off among ecological as well as economic indicators of

Table 13.3 Comparing small farms in different agro-climatic zones using organic practices, using different methods

	Ecological				Economic				Socio-cultural			
	MCA	PIA	SEM	TCG	MCA	PIA	SEM	TCG	MCA	PIA	SEM	TCG
Northern dry	***	***	**	**	*	***	~	**	*	***	*	NA
Coastal	**	***	*	**	**	***	***	*	*	**	*	
Southern transitional	**	***	*	*	**	***	↓↓	~	*	***	↓	
Eastern dry	**	***	*	***	*	***	*	*	**	***	*	
Central dry	**	***	*	**	**	**	↓	**	**	***	***	

Key: Much better ***, Better **, Marginally Better *, No Change ~, Bad ↓↓, Slightly worse ↓

sustainability of small holders using organic inputs. However, socio-cultural trade-off was observed in all the sites except one. Another important finding was improved sustainability performance of organic farming policies in small and rain-fed farms compared to large and irrigated farms. These findings also emphasize that the small and rain-fed farms could move towards sustainability with respect to all the three criteria by way of organic inputs produced on-farm rather than purchasing the same from outside the farm (for more discussion about this, see also Purushothaman et al. 2012b). This result was consistent in both the quantitative methods. These findings are handy in strategizing micro-level planning in public investments for sustenance of small holders through self-reliance in inputs.

The results of the participatory impact assessment were purely dependent on the perceptions of stakeholders gathered during the exercise of ranking land use functions and scoring the impact of scenarios on indicators of land use functions. Farmers were most concerned about their family's heath, soil moisture, and food security. Voluntary organizations were of the same opinion as farmers, whereas some difference in preference was observed between these two and the researchers group. They seemed to give more importance to functions of land like production and agrodiversity. The choice aligned with the two key objectives of food production and food security (Thrupp 2000) (Fig. 13.4).

Yet, participants were not sure of continuing with sustainable farming practices, as it was easier to adopt conventional practices with quicker access to subsidized chemical inputs. Inadequate supply of organic inputs and lack of definite price incentive and market for organic products added to this. However, one thing that notably emerged from this exercise was that farmers were concerned about socio-ecological (such as soil and water quality, family's health, food security, etc.) dimensions of agriculture, which usually are ignored by most policy assessments or agricultural research (Fig. 13.5).

Fig. 13.4 Finger millet haystacks to feed cattle during summer

The bio-physical model was adopted to compare the sustainability potential of organic vis-à-vis conventional farming practices in two different time periods. The assessment used environmental indicators such as nutrient balance in soil, nitrogen loss by leaching and volatilization, and economic indicators such as yield level and profit. This model is heavily based on bio-physical data input that includes crop rotation, production techniques, precipitation, evapotranspiration, soil properties, and fertilizer and pesticide use. Technical coefficients were generated such as that of yields and animal products, fertilizer requirement, nutrient losses and balance, biocide use and index, water requirement, labor use, fuel, machine, animal and seed use, cost per input, and profits. Findings of the bio-physical model were unique in suggesting that organic farming may cause nutrient depletion in drier areas than wetter areas, leaving the soil less fertile after some years in the absence of enough organic inputs. However, in economic terms, the input costs in organic farming practice were much lower than conventional practices, making it less risky in a time of crop failure (Figs. 13.5, 13.6, 13.7, and 13.8).

Profits projected with organic farming were much more in dry areas than in wet areas. Selection of the right crop in the right rotation made a lot of difference in both the areas. Thus, with improved nutrient management and with enough livestock, utilizing crop residue and improved ways of making compost on the farm were suggested to be most effective in maximizing sustainability potential.

Agricultural policies with a focus on sustainability were initiated by the state government as a mixed bag of financial, technological, and social intervention with focus on target groups with assistnace from local implementing agencies. Effect of such an effort was felt by a range of stakeholders. Using qualitative data about the effect, the impact hub developed in Purushothaman et al. (2013) depicted intensity and direction of effect on each stakeholder group. Focus group discussions with different stakeholders found that there were more stakeholders on the positive impact side of hub than on the negative side. Governance support for the continuation of organic practice was discussed as one of the crucial factors which coaxed and cajoled farmers to adopt it. This needed some clarification, and hence, six governance indicators the policy were assessed. These six indicators include potential continuity and improvement of indigenous practices envisaged by the policy and awareness generated during the implementation process. They were assessed from farmers' responses during focus group discussions in all the study villages.

Feedback from three main stakeholders engaged at the time of implementation of the policy (KSPoOF)—non-governmental organizations, officials from state department of agriculture, and farmers themselves—was cross-checked and finalized in consultation with the other two groups. Focus group discussions separately with each group revealed that awareness about natural

Fig. 13.5 Small farmer using ox for land preparation

Fig. 13.6 Woman separating husk from grains of finger millet

Fig. 13.7 Millet diversity harvested by small farmers

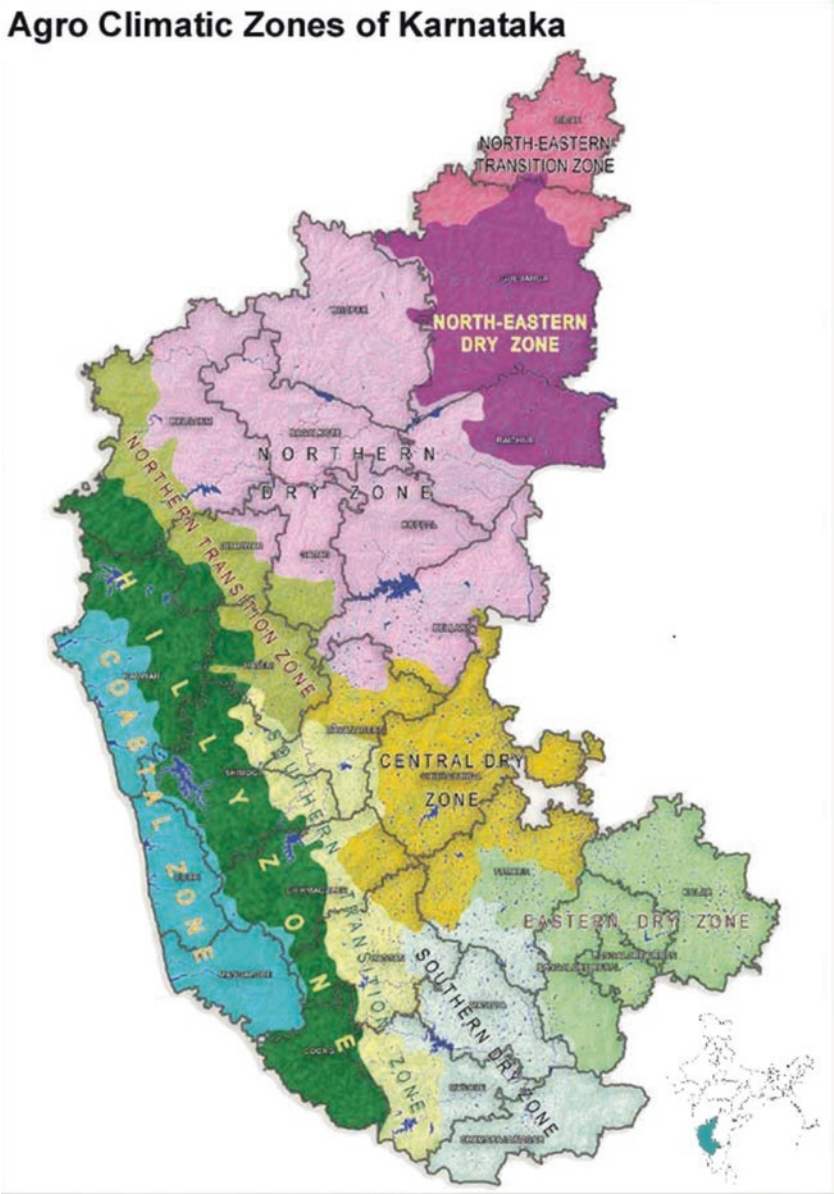


Fig. 13.8 Map of agroclimatic zones in Karnataka

resource management issues among farmers across all the study villages was a clear pointer to the potential continuation of the said policy. Institutional efforts in promoting sustainable agricultural practices were relatively more effective in less developed districts in the northern dry zone. Efficacy of

government officials and completeness in the implementation of all components in the schemes emerged crucial for spreading the policy support to larger number of farmers. In brief, inclusive design of policy and participatory governance were crucial for effective agricultural natural resource management and sustaining small-farm livelihood, with better ecological outcomes and social acceptance.

A clear mismatch emerged between the factors that were envisaged by farmers as most important functions of their land and what the government assumes are important while providing them any development package. Yet, most policy and investment recommendations were in line with the latter, especially with regard to seeking increased private and public investment for productivity enhancement, research and technology, infrastructure, and so on. Policy and institutional design need to cater to a synergistic outcome to be accepted by farmers. Farmers' preference for social and ecological factors, such as food and water security, family's health, and soil quality, were some of the most obviously absent concerns even in agricultural research. An NRM intervention of sustaining small farms could be initiated and guided centrally with local solutions for each agroclimatic region. Concerns raised by small farmers may not be as same as large holders. Thus, inclusive governance with focus on priorities of the large number of small and marginal holders was crucial in Indian agriculture.

Lessons Learned

- State agricultural institutions (executive and research) form one of the oldest and largest line agencies in Indian rural scene. Their regular interventions have been around technology extension and assistance in times of calamities and provision of access to subsidized fertilizer and seeds. Other support packages from the government include populist measures like loan waivers and free electricity. Despite the large public expenditure on agriculture (INR 124 billion or 13.4 percent of total expenditure during the year 2014–15 in Karnataka, for instance), agrarian distress persists. This mismatch calls for a rethinking of agricultural governance in the country. This study shows that the agricultural vision for the country should be anchored on and derived from the large population of small holders while changing its presumptions on what is good for the sector. Study also shows that sustainable food production could mean sustainable livelihoods if the policy makers' can adorn an approach that can integrate sustainability along with production. This in turn will need an emphasis

on effective natural resource management. Fortunately, the study reveals alignment between farmers' preferences with the integrated approach to sustainability.

- Mitigation of the state-center mismatch on the abovementioned vision and approach is crucial for the above, so that conflicting policies and sessages are avoided.
- Integration of sustainability concerns into agricultural governance will depend on effective policy design, informed officials, vibrant local institutions, rigorous but socio-ecologically relevant research and innovative technologies and incentives for integration.
- If the above approach is not too popular across the world, that shouldn't be a concern for the Indian agricultural scene dominated by large number of small holders operating in diverse ecological contexts. Since the problems with agrarian sector are unique in India, policy and schemes designed for any other region or country may not work effectively here.
- Policies, efforts, and institutions to minimize the damage caused by improper practices in farming have been conspicuous by absence. What was missing was well-informed governance strategies that could recognize the multi-functionality of agrarian land use, importance of on-farm management of natural resources for sustained productivity in tandem with socio-cultural aspects.
- In order to synchronize the otherwise divergent policy directions and achieve some balance among the multiple dimensions of sustainability, impact assessment is inevitable. Additionally, impact assessment with integration of various tools would give clarity on the possibility of long-term agricultural goals.
- While decentralization (Panchayat Raj Act as in 1992 and 73rd Constitutional Amendment) in principle could have led to integrated but localized visions for farming, the unfortunate awareness gap at the local scale on what is desirable for the local communities didn't enable this potential realization. This lack of proactive agricultural envisioning at local scale was also a result of confusing and perverse signals in the economy, science, and extension agencies.

Notes

1. Of the negative environmental effects of the Green Revolution included ground water depletion (Matson and Parton 1997), soil degradation (Giller et al. 1997; Singh 2000), loss of crop genetic diversity (Thrupp 2000; Tilman

et al. 2002), and increased pesticide concentration in food products (Gupta 2004). Although pesticide use is relatively low in India, pesticide residue problem is high in India (Abhilash and Singh 2009). Other impacts like regional disparities and social issues (Bhalla and Singh 2009).

2. Press Information Bureau 2008, "India needs second green revolution" Prime Minister's address. Global Agro Industries Forum, India needs second green revolution, available at http://pib.nic.in/newsite/erelease.aspx?relid=37279.

References

Abhilash, P.C., and Nandita Singh. 2009. Pesticide Use and Application: An Indian Scenario. *Journal of Hazardous Materials* 165 (1–3): 1–12.

Abraham, V. 2009. Employment Growth in Rural India: Distress-Driven? *EPW* 44 (16): 79–94.

Acharya, S.S., and R.L. Jogi. 2004. Farm Input Subsidies in Indian Agriculture. *Agricultural Economics Research Review* 17 (1): 11–41.

Bhalla, G.S., and G. Singh. 2009. Economic Liberalisation and Indian Agriculture: A Statewise Analysis. *EPW* 44 (52): 37–44.

Bhattacharyya, P., and G. Chakraborty. 2005. Current Status of Organic Farming in India and Other Countries. *Indian Journal of Fertilizers* 1 (9): 111–123.

Bouma, J. 1997. The Role of Quantitative Approaches in Soil Science When Interacting with Stakeholders. *Geoderma* 78: 1–24.

Bruges, M., and W. Smith. 2008. Participatory Approaches for Sustainable Agriculture: A Contradiction in Terms? *Agriculture and Human Values* 25: 13–23.

Cai, Y.L., and B. Smith. 1994. Sustainability in Agriculture: A General Review. *Agriculture, Ecosystems and Environment* 49: 299–307.

Chand, R., P.A.L. Prasanna, and A. Singh. 2011. Farm Size and Productivity: Understanding the Strengths of Smallholders and Improving Their Livelihoods. *Economic and Political Weekly* 46 (26 & 27): 5–11.

DES. 2010. *Agricultural Census*. Directorate of Economics and Statistics.

Dev, M. 2012. *Policies for Raising Agricultural Growth and Productivity in India. IGIDR Proceedings PP-069-SMDI.*

Deshpande, R.S. 2002. Suicides by Farmers in Karnataka: Agrarian Distress and Possible Alleviatory Steps. *Economic and Political Weekly* 37 (26): 2601–2610.

———. 2008. Rapporteur's Report on Rainfed Agriculture. *Indian Journal of Agricultural Economics* 63 (3): 565–576.

Ellis, F., and S. Biggs. 2001. Evolving Themes in Rural Development 1950s to 2000s. *Development Policy Review* 19 (4): 437–448.

Fan, S., A. Gulati, and S. Thorat. 2008. Investment, Subsidies and Pro-poor Growth in Rural India. *Agricultural Economics* 39: 163–170.

Giller, K.E., M.H. Beare, P. Lavelle, A.M.N. Izac, and M.J. Swift. 1997. Agricultural Intensification, Soil Biodiversity and Agro Ecosystem Function. *Applied Soil Ecology* 6 (1): 3–16.

Government of Karnataka. 2006. *Karnataka State Policy on Organic Farming*. Commissionerate of Agriculture. http://raitamitra.kar.nic.in/kda_booklet.pdf. Accessed 21 Nov 2010.

Gulati A., P.K. Joshi, and M. Landen, ed. 2008. *Contract Farming in India: A Resource Book*. http://www.ncap.res.in/contract_%20farming/Resources/2.1%20Ashok%20Gulati.pdf. Accessed 22 Sept 2011.

Gupta, P.K. 2004. Pesticide Exposure—Indian Scene. *Toxicology* 198: 83–90.

Hansen, J.W. 1996. Is Agriculture Sustainability a Useful Concept? *Agricultural Systems* 50: 117–143.

Human Development Report. 2016. *Karnataka State Human Development Report*. Planning Commission.

India Economic Survey. 2010–11. http://indiabudget.nic.in/survey.asp.

Jha, D. 2003. Policy Drift in Agriculture. *EPW* 38 (47), November 22–28.

Lozano, Rodrigo. 2008. Envisioning Sustainability Three-Dimensionally. *Journal of Cleaner Production* 16 (17): 1838–1846.

Matson, P.A., and W.J. Parton.1997. Agricultural Intensification and Ecosystem Properties. *Science* 577 (5325): 504–509.

MoEF. 2001. *State of the Environment Report: Land Degradation*. http://moef.nic.in/soer/2001/ind_land.pdf.

Morris, Jake Breton, Valentina Tassone, Rudolf de Groot, Marguerite Camilleri, and Stefano Moncada. 2011. A Framework for Participatory Impact Assessment: Involving Stakeholders in European Policy Making, A Case Study of Land Use Change in Malta. *Ecology and Society* 16 (1): 12.

Narayanamoorthy, A., and S.S. Kalamkar. 2005. Indebtedness of Farmer Households Across States: Recent Trends, Status and Determinants. *Indian Journal of Agricultural Economics* 60 (3): 290–301.

Patil, S., P. Reidsma, P. Shah, S. Purushothaman, and J. Wolf. 2012. Comparing Conventional and Organic Agriculture in Karnataka, India: Where and When Can Organic Farming be Sustainable? *Land Use Policy* 37: 40–51.

Pretty, J.N. 1995. *Regenerating Agriculture: Policies and Practice for Sustainability and Self-reliance*. Washington, DC: World Resources Institute.

Pretty, J., G. Smith, K.W.T. Goulding, S.J. Groves, I. Henderson, R.E. Hine, V. King, J. van Oostrum, D.J. Pendlington, J.K. Vis, and C. Walter. 2008. Multi-year Assessment of Unilever's Progress Towards Agricultural Sustainability I: Indicators, Methodology and Pilot Farm Results. *International Journal of Agricultural Sustainability* 6 (1): 37–62.

Purushothaman, S., and S. Kashyap. 2010. Trends in Land Use and Crop Acreages in Karnataka and Their Repercussions. *Karnataka Journal of Agricultural Science* 23 (2): 330–333.

Purushothaman, S., S. Patil, I. Francis, H.J. König, P. Reidsma, and S. Hegde. 2012a. Participatory Impact Assessment of Agricultural Practices Using the Land Use Functions Framework: Case Study from India. *International Journal of Biodiversity Science, Ecosystem Services and Management*. https://doi.org/10.1080/21513732.2012.721005.

Purushothaman, S., S. Patil, and I. Francis. 2012b. Impact of Policies Favouring Organic Inputs on Small Farms in Karnataka, India: A Multicriteria Approach. *Environment, Development and Sustainability* 14: 507–527.

———. 2012c. Assessing the Impacts of Policy-Driven Agricultural Practices in Karnataka, India. *Sustainability Science*. https://doi.org/10.1007/s11625-012-0188-y.

Purushothaman, S., S. Patil, I. Patil, I. Francis, and I. Nesheim. 2013. Policy and Governance for Sustaining Livelihoods and Natural Resources in Small Farms: A Case Study in Karnataka. Indian Journal of Agricultural Economics, 68 (2): 240–257.

Rajivlochan, M. 2008. Rejuvenating Agriculture with the Help of the Small Farmers. *Economic and Political Weekly* 43 (11): 17–21.

Reddy, D.N., and S. Mishra. 2009. *Agrarian Crisis in India*. New Delhi: Oxford University Press.

Reddy, B.S. 2011. Dynamics of Soil Fertility Management Practices in Semi-Arid Regions: A Case Study of AP. *Economic and Political Weekly* 51 (3): 56–63.

Rigby, D., and D. Cáceres. 2001. Organic Farming and the Sustainability of Agricultural Systems. *Agricultural Systems* 68 (1): 21–40.

Singh, R.B. 2000. Environmental Consequences of Agricultural Development: A Case Study from the Green Revolution State of Haryana, India. *Agriculture, Ecosystems and Environment* 82: 97–103.

Singh, K. 2009. Environmental Degradation and Measures for Its Mitigation with Special Reference to India's Agricultural Sector. *Indian Journal of Agricultural Economy* 64 (1): 40–61. Lozano.

State of the Environment Report. 2003. Environmental Management and Policy Research Institute.

Thrupp, L.A. 2000. Linking Agricultural Biodiversity and Food Security: The Valuable Role of Agrobiodiversity for Sustainable agriculture. *International Affairs* 76 (2): 265–281.

Tilman, D., K.G. Cassman, P.A. Matson, R. Naylor, and S. Polasky. 2002. Agricultural Sustainability and Intensive Production Practices. *Nature* 418: 671–677.

Von Wirén-Lehr, S. 2001. Sustainability in Agriculture—An Evaluation of Principal Goal-oriented Concepts to Close the Gap Between Theory and Practice. *Agriculture Ecosystems and Environment* 84: 115–129.

14

Japanese Women and Antinuclear Activism After the Fukushima Accident

Heidi Hutner

Background

There is a long history of female and maternalist engagement in antinuclear activism in Japan and worldwide, dating back to the bombing of Hiroshima and Nagasaki in 1945. These female-driven movements arise at moments of disaster like nuclear reactor meltdowns and contamination from atomic bomb testing. In *Women Strike for Peace: Traditional Motherhood and Radical Politics in the 1960s*, Ann Swerdlow examines the ways in which American mothers organized and were largely responsible for the end of US atmospheric bomb testing (1993). Women's League for Peace and Freedom, from which Women Strike for Peace was an offshoot, also has a long history of involvement with movements to ban the bomb globally. There are many affiliate ban-the-bomb groups, many of which are women led (antinuclear bomb groups are generally antinuclear power as well). Swerdlow's book explores this history. When investigating women, radiation, and post-Fukushima activism, a range of scholarly and creative work should be considered. "Young Mothers Looking for a Voice in Post-3.11 Fukushima," by David J. Slater et al. (2014), and "Fukushima Women Against Nuclear Power, Finding A Voice in Tohoku," by David Slater (2011), provide important background on women, activism, and Fukushima, specifically. Kendra Ulrich's 2017 report on the nuclear disaster's unequal impact on women and children provides a vital overview of the social, economic, and health repercussions of the nuclear accident. In

H. Hutner (✉)
Stony Brook University, Stony Brook, NY, USA

R. Brinkmann, S. J. Garren (eds.), *The Palgrave Handbook of Sustainability*,
https://doi.org/10.1007/978-3-319-71389-2_14

Radiation Brain Moms and Citizen Scientists: *The Gender Politics of Food Contamination After Fukushima*, Aya Hirata Kimura looks at the double bind women in Japan face when providing their children with radiation-safe food (2016). Additionally, I have written extensively on gender and activism post-Fukushima, including "Radiophobia, Women, and Patriarchy" (2018), "Women and the Fukushima Disaster" (2017), "Invisible Victims" (2015b), "Aileen Mioko Smith: Anti-Nuclear Feminist" (2015a), and "In Japan, A Mother's Movement Against Nuclear Power" (2012).

The work of evolutionary biologist, Tim Mousseau, is helpful to understanding the impact of gender and radiation on animals and insects in Chernobyl and Fukushima (2011, 2015). The analyses of the 2006 National Health Science report on radiation impacts on humans, by Arjun Makhijani and Mary Olson, provide important data on why gender matters when considering the question of women, children, radiation post-Fukushima and the disproportionate health impacts of the disaster (Makhijani 2008; Olson 2012, 2014). This vital data buttresses the concerns of women and mother activists, revealing that women and children are at much greater risk of harm from the Fukushima disaster than health officials publicly acknowledge. This analysis does not include impacts from internal contamination, which indicates potentially even higher rates of health concerns for children, women, and all adults post-disaster (Mary Olson, personal interview with Heidi Hutner, June 21, 2017). Remarkably, the question of unequal gender and health impacts in radiation disaster contexts has recently been taken into consideration in the Preamble to the 2017 UN Treaty to Prohibit the Use of Nuclear Weapons. Women have been at the forefront of these negotiations, and the UN conference in June 2017 on banning the bomb was chaired by a woman, Elayne G. Whyte Gómez, Costa Rica's ambassador, who supports this gender and age-sensitive precautionary measure.

Case Study

On March 11, 2011, the Tohoku region of Japan was struck by an earthquake, measuring nine on the ten-point Richter scale. A violent tsunami ensued, resulting in power outages and the meltdown of three (out of the six) reactors at the Fukushima Daiichi Nuclear Power Plant. All three cores melted through the steel of the reactors and leaked into the containment vessels. Water contact with the zirconium-clad exterior of the fuel rods caused reactor units 1, 2, 3, and 4 to have hydrogen explosions and massive amounts of radiation were released into the atmosphere, including cesium, tritium,

iodine, strontium, silver, plutonium, americium, rubidium, and the noble gases argon, xenon, and krypton. Twenty percent of the poisonous releases dispersed over mainland Japan, and 80 percent traveled offshore to the Pacific. Four thousand five hundred square miles were contaminated with radiation above Japan's (then) allowable exposure limit of 1 millisievert (mSv) per year. Not long after the accident, the Japanese government raised the acceptable yearly limit of radiation exposure to 20 mSv.[1]

It took nearly two months for the Japanese government to publicly admit the extent to which the radiation had been released. During that same period, the government changed their definition of acceptable radiation from 1 mSv to 20 mSv, thereby minimizing the number of evacuation zones. These two factors contributed significantly to citizen mistrust of the Japanese government's position regarding radiation safety. Many citizens believed that the elevation of radiation limits put their health at risk, causing alarm and concern around the accuracy of information dispensed by the media and governmental sources (Oya, Hanayo and Hideaki, Kimura, personal interview with Heidi Hutner, April 29, 2017). All 54 nuclear power plants in Japan were shut down immediately post-disaster, and, as of March, 2017, only three of the 45 operable reactors had come back online. Pro-nuclear factions continue to press for more reactor station restarts.

A surge in antinuclear sentiment and actions post-Fukushima was directly related to the fear of future nuclear meltdowns and a general mistrust of both the nuclear industry and the government (Murphy 2014). Large numbers of women and mothers led and joined in antinuclear actions—countering the ideology of the pro-"nuclear village," a triangle of nuclear vendors, bureaucracy, and Japan's parliament. In doing so, Japanese women and mother activists challenge traditional concepts of female identity, in which they are expected to be submissive, conformist, and silent (Kingston 2013).

Mass antinuclear protests, often women and mother-led, took place around post-Fukushima Japan and Tokyo with as many as 60,000 to 170,000 protestors at one time. They marched to demand the cleanup of Fukushima, the lowering of radiation levels, and the permanent closure of nuclear reactors nationwide. Busloads of residents from Fukushima regularly descended upon Tokyo and formally "occupied" the space in front of the Ministry of Economy, Trade, and Industry (METI), constructing a tent city where protestors lived for months. For more than six years, activists protested (and continue to protest) in front of the Prime Minister's home every Friday. While mass public displays of protest diminished in size by 2015, women and mothers continue to file lawsuits over the call to return families to contaminated areas, declaring it a human rights violation; they persist in their vigilance with citizen science

radiation food protection, soil sampling, and medical oversight; and they carry on with activist efforts to keep nuclear reactors closed.

Kendra Ulrich reports that women and children have suffered "unequal" impacts from the nuclear disaster—including increased domestic abuse and violence, divorce, economic hardship, negative health impacts, and social isolation (2017). Fukushima mothers and their children are often ostracized—viewed as radiation-tainted, contemporary "Hibakusha" (Jacobs 2013), a term first used to describe survivors of the atomic bomb. Female survivors of Hiroshima and Nagasaki, in particular, experience extreme social exclusion. After many women gave birth to infants with birth defects within nine months of the bombings, female Hibakusha were labeled unfit for motherhood and marriage (Alexis-Martin 2015). Even second-generation Hibakusha remain outcasts and considered unfit to bear children. Recent (but separate) analyses of the 2006 National Academy of Science Health report by Arjun Makhijani and Mary Olson show that women and children are most vulnerable to and suffer disproportionately from radiation exposure, and fetuses are most vulnerable of all (2008, 2012, 2014). Adult women are twice as likely to develop cancer from the same exposure to ionizing radiation as adult men, and children are at least five to seven times as likely to develop cancer from those same exposures, and fetuses are the most vulnerable of all (Makhijani, Olson). Epidemiologist Alice Stewart first discovered the effects of ionizing radiation on a fetus in the 1950s; her research determined that a single X-ray to the womb doubled a child's likelihood of developing cancer. However, radiation safety regulations are measured according to the white, adult male body—the standard "Reference Man." Makhijani, Olson, and Hutner suggest this regulatory measurement poses a racial and gender injustice (2008, 2012, 2015b, 2018). The gender and racial injustice of the "Reference Man" safety standard has been confirmed in conference discussions at the UN and in global debates about nuclear power and weapons. More needs to be done on the racial inequities and impacts, but the gender and age inequity factors are on the UN policy table largely due to the efforts of Mary Olson, who has pressed for the rights of girls and women through her Gender and Radiation Project.

In *Radiation Brain Moms and Citizen Scientists*, Aya Hirata Kimura looks at the double bind of mothers in post-Fukushima Japan. If mothers question the governments' commitment to radiation safety, they are labeled as "radiation brain moms"—hysterical women who don't understand science (2016). Cindy Folkers (2017) (Hutner and Folkers) argue that the marking of concerned mothers as "radiophobic" erases their legitimate health questions. Such attacks on women date back to the 1950s in the USA when the American government wanted to assure the general public that atmospheric bomb testing was safe. Folkers

(Hutner and Folkers) suggest that calling concerned women radiation brain moms or radiophobic normalizes radiation dangers and potentially silences women and others (2017, 2018). Executive director of *Green Action Japan,* Aileen Mioko Smith states, "In general, men don't take radiation dangers as seriously as do the women—men worry more about finances, while women worry about their children's safety—where they play and what they eat. This may be because it's the women who have to deal with the day-to-day of the children's needs" (Aileen Mioko Smith, Skype interview, February 22, 2014). The antinuclear female-driven counter-culture movement reflects the deep social impact of the nuclear disaster: shifting female gender roles and a rising nascent feminism. The differing gender views regarding nuclear power and radiation safety often result in what is commonly referred to as an "atomic divorce" (Ulrich 2017).

Japanese women's antinuclear activism began long before Fukushima, originating with the Hibakusha and the global women's antinuclear peace movement. In particular, as Toshiro Higuchi points out, the tragic bomb testing of Bikini Atoll in 1954, in which the Japanese *Lucky Dragon* commercial fishing boat was accidently contaminated, led to an important awakening of women's antinuclear activism and environmental awareness in Japan. The Atoll disaster called attention to the environmental health threat of ionizing radiation on fish populations, a key food source for the Japanese. Higuchi argues that the *Lucky Dragon* fish contamination was an important moment of awakening regarding radiation safety in Japan, and mothers (the food keepers) spearheaded the antinuclear actions in response. The Bikini Atoll event led to the ban-the-bomb petition, signed by 1,500 housewives. Unwilling to stop there, these women gathered 170,000 signatures opposing the use of nuclear weapons and took on the role of global nuclear peacekeepers (Higuchi 2008). The Hibakusha have also served as symbolic global nuclear peacekeepers and spokespersons for world peace. Since the Fukushima disaster, the Hibakusha have become outspoken opponents of nuclear power as well—a population growing in numbers as post-Fukushima antinuclear activists self-identify as "Hibakusha" (Ogawa 2013). The Hiroshima and Nagasaki Hibakusha refer to the Fukushima disaster survivors as the "third Hibakusha." The original Hibakusha and the many "ban-the-bomb" groups speak of the need to abolish nuclear power and directly link the dangers of nuclear weapons with nuclear power (Fig. 14.1).

Thirty-two years before Fukushima, the Three Mile Island partial nuclear meltdown in Pennsylvania drew the attention of Japanese women activists. Aileen Mioko Smith, co-author of *Minamata: The Story of the Poisoning of a City, and the People Who Choose to Carry the Burden of Courage* (1975), an account of how 100,000 people contracted Minamata disease from methyl

Fig. 14.1 Women's ban-the-bomb March in New York City, June 17, 2017

mercury-contaminated fish in Minamata Bay, came to the USA to interview 250 residents of Three Mile Island area for six months after the March 1979 accident. In Mioko Smiths' research, she found that the locals living near the Three Mile Island nuclear plant had strange ailments and many of their animals had become sick. Yet, Mioko Smith states, this information regarding the meltdown was not recorded in the mainstream US press. Mioko Smith became alarmed as she considered the many nuclear power plants in Japan and the intense seismic activity there. She then decided to return to Japan and do all that she could to shut the Japanese nuclear plants down (Smith, personal interview, February 22, 2014). Mioko Smith eventually formed the group, *Green Action Japan*, and worked on multiple antinuclear campaigns. In 1988, Mioko Smith gathered four million signatures in request of a ban on nuclear power. Over several decades, she rallied for the moratorium on MOX fuel use in commercial plants and led countless nuclear rallies, petitions, sit-ins, and appeals before corporate and political boards. The Fukushima story is a feminist one, Mioko Smith says, as the nuclear industry in Japan is overwhelmingly male dominated and all decisions are in the hands of men. She states that these men who control the nuclear village do not listen to the women's demands or concerns. Still, she does not give up hope and persists in her many projects to protect the children and people of Japan (Aileen Mioko Smith, personal interview, February 22, 2014).

An organic farmer and mother of five, Sachiko Sato is an important example of post-Fukushima female radicalization. Sato became an activist after the 2011 accident when her family lost their "Yanamani" farm due to radiation contamination. They were forced to permanently abandon their home, community, and entire way of life. The impact on Sato's family was severe—her youngest child Mina (12) suffered from depression and anxiety, her older daughter divorced, and she too divorced. The family divided and spread to various locations in Japan. Their thriving educational organic farm, which Sato and her family had built over 30 years, was closed in April 2011, and Sato had to kill their 250 chickens—all contaminated. In order to survive economically and support her children, Sato stayed in Fukushima City after the disaster, where she works in a facility for the disabled and elderly. To protect her children from radiation exposure, Sato sent them to live several hours away from where she worked and resided. Since then, protecting the children and people of Fukushima has been her life purpose—setting up private medical testing facilities, doing citizen science, growing safe food, creating safe food outlets, protesting, speaking publicly, and moving children to safe facilities.

Kaori Izumi (now deceased) is another example of Japanese female radicalization. She had been living in Italy prior to the Fukushima accident, but when she saw what was happening in Japan on TV with the nuclear explosions, she decided to return home to help with antinuclear actions (Izumi, personal interview with Heidi Hutner, November 9, 2012). Izumi, along with Mioko Smith, was part of the protest group to camp out in front of METI for ten months and ten days. This time period—considered by the Japanese to be the period of a human gestation—was intended to draw attention to the harmful impact of radiation to the fetus in the womb. Izumi partially financed the legal battle to prevent the Tomari Nuclear Power Plant from reopening, and she created radiation-safe nature camps to where children were evacuated from contaminated areas. Izumi worked to protect these children while she suffered through terminal cancer, spending her final days as an activist. Izumi, Sato, and Mioko Smith traveled to New York in September 2011 to speak out as a Japanese delegation about the need to shut down nuclear power plants worldwide. They participated in a large rally in front of the UN and spoke at the Ethical Culture Society in Manhattan. They met with various concerned citizen groups in Westchester, New York, to share their stories of Fukushima and the disaster's impact on Japan (Fig. 14.2).

The story of Ikuko Nitta—a divorced, single mother of three—offers another vital account of female radicalization post-Fukushima. Nitta lived in Fukushima at the time of the accident, and she fled with her children three

Fig. 14.2 Ikuko Nitta speaks at a public meeting about the dangers of radioactive rubble in Japan, 2011. Her sign says: "I evacuated Fukushima"

days after the disaster to Wakayama. After the move, Nitta's 12-year-old son suffered severe anxiety and social isolation; he was bullied for being a "Fukushima boy" (Nitta, e-mail correspondence and personal interview with Heidi Hutner, April 23, 2017). The whole family experienced radiation health symptoms—nausea, vomiting, nosebleeds, and the cracking and peeling of their skin. Two of Nitta's children tested positively for (internal) cesium 137 contamination (only two of the three were tested). "Japan is a conformist culture," Nitta explains, "and I wasn't comfortable with speaking up. Yet, I had to speak out" (Ikuko Nitta, personal interview with Heidi Hutner, April 23, 2017). Her first step was food safety. However, sending children with home-prepared meals to school is not acceptable in Japan. Nevertheless, Nitta insisted that her children be allowed to bring their meals to school; she tested their food with a geiger counter and purchased ingredients from reliable sources. Nitta's experience is echoed in the stories documented in *Radiation Brain Mom* and Ian Nash's documentary *A2-B-C,* a film exploring the challenges of mothers and children living safely in the post-Fukushima era (2013). In Nash's film, the mothers worry about radiation food safety and safety in the school playgrounds because of ionizing radiation hotspots located adjacent to these areas; many of these mothers directly confront and battle with school authorities.

Nitta also became involved in the campaign to stop the burning of radioactive rubble in Japan—debris that had been scattered by the tsunami and reactor explosions. Nitta had moved to the Wakayama prefecture to escape the contamination in Fukushima, but once there, the prime minister announced that radioactive rubble would be burned all over the country as a way of dispersing the pollutants. Nitta, her colleague Cathy Iwane, and others petitioned and spoke in opposition to the planned incineration. Both Nitta and Iwane ended up leaving Japan with their children when their activist efforts did not succeed, as they feared for their children's safety. Iwane moved to the USA where she continued with her activism. In California, she helped to successfully shut down the failing San Onofre Nuclear Generating Station, just outside of San Diego. Nitta moved with her children to Malaysia, and then Canada, where she joined up with other Japanese evacuees.

Tomoi Zeimer, a Japanese mother living in New York City in the USA, took up activism post-Fukushima as well. Having adopted a baby from the Fukushima region, Zeimer felt she had to do "something to help" her "family at home" after the disaster. Zeimer's parents and two sisters still live in Japan, and her baby's biological teen mother resides in the Fukushima area (personal interview with Heidi Hutner, April 23, 2017). Zeimer led the international campaign to stop Japan's burning of radioactive materials. She acquired thousands of signatures and the petition was delivered to Japanese embassies in London, New York, and several European cities. With Yuko Tonohora, Ziemer also organized a large antinuclear rally in New York City to commemorate the second anniversary of the Fukushima accident. Hundreds marched up Fifth Avenue with members of Occupy in tow, carrying signs, images of pregnant Japanese women, and hand-sewn banners. The pictures of pregnant mothers called overt attention to the dangers that women and children face in nuclear disaster contexts (Fig. 14.3).

Antinuclear activism is a legacy that has been passed down through multiple generations of Japanese children. Sachiko Sato's youngest daughter Mina, for example, was drawn to antinuclear advocacy after her own post-disaster journey. Initially, Mina felt tremendous loss and grief over losing the family farm community and way of life. After Mina completed middle school, she was sent to a Christian boarding school far away from Fukushima City where Sato, her mother, felt she could study and live safely—radiation-free. At first Mina cried and refused to go. Mina felt abandoned and resented her mother's constant attention to the problems of the disaster and her caring for other children harmed by the accident. Finally, Mina agreed to go away. When in boarding high school, Mina wrote letters to her mother about the difficulty of the transition from her life on their family farm where, following her mother

Fig. 14.3 Tomoi Zeimer with her daughter Yael, born near Fukushima. Zeimer led the action to stop the burning of radioactive rubble in Japan (Photo by Olivia fine 2011. All rights reserved)

through the "green field[s]," she had been the "happiest person on earth." After the Fukushima disaster, Mina wrote, "everything had broken." Mina explained that she hoped to build her own organic farm like the family's lost farm, Yanamani. One day, at Mina's school mass, in a session where the teens were encouraged to speak about themselves to the group, she had an awakening. Mina recognized that she had to face the reality of radiation dangers and she spoke out. She told her classmates that she realized it was a "sin" to ignore the dangers of the Fukushima disaster, and the problems of radiation contamination must be faced head-on. Mina then knew she had to continue to communicate this information publicly and help others, and so she, too, became an antinuclear activist. In a public antinuclear event in 2014, Mina described the Fukushima disaster as "a black rain like Hiroshima" and she called on her audience to take action. Mina pointed out that as "long as there are nuclear power plants in Japan, no Japanese [person] should be ignorant… The black rain may fall upon you or on the beautiful Mount Fuji" (Sato, Mina, personal correspondence with Sachiko Sato, dates May 1, 2014; October 12, 2014).

Today, many years after the Fukushima disaster, activist women in Japan continue to work in opposition to nuclear power, support the decommissioning of nuclear weapons, and seek world peace. Groups like The Hibakusha Project,

Fig. 14.4 Women (including Aileen Mioko Smith) celebrating at the end of "a sit" in front of METI in Tokyo on November 5, 2011. The ball of yarn had been woven by the women of Fukushima and was encircled first around the METI building and then made into the ball, as a symbol of the birth of a new earth. The text in the photo states, "We will Protect the Fukushima Children," "Women Don't Need Nuclear Power," and "Women will change the world"

Peace Boat, Green Action Japan, Women of Fukushima Against Nukes, International Campaign to Abolish Nuclear Weapons (ICANW), Reaching Critical Will, and many women- and mother-led NGOs both in Japan and globally persist in their efforts to protect the environment and humans from radiation contamination. They link nuclear power with nuclear weapons and see the industry as a danger to all life on earth. As David J. Slater argues in "Fukushima Women against nuclear power, finding a voice in Tohoku," women play a vital role in antinuclear activism, and they are uniquely positioned to do so (2011). The multiple nuclear disasters in Japan have altered Japanese female identity in substantial ways. Like the seismic activity beneath Japan's surface, such shifts are not always fully visible or comprehensible, that is, until they erupt and embedded gender systems are changed (Fig. 14.4).

Lessons Learned

To be sustainable and equitable, we must consider the full bearing of a technology and its long-term impacts on all humans and the environment—including women, children, and all biotic life. Evolutionary biologists, such as Mousseau, find significant genetic damage in animals, especially in female

animals, from radiation exposures post-Fukushima and Chernobyl. It is too early to know the full extent of health and environmental impacts in humans after the Fukushima disaster, but children are developing precancerous and cancerous thyroid tumors even at this early date and studies show that radiation exposures cause irreparable genetic damage, particularly in the fetuses, babies, children, and women (McCollough et al. 2007; Wo and Viswanathan 2009; Brent 2008; Olson 2012, 2014; Makhijani 2008). Long before March 2011, the work of women in radiation science and health who warned of its dangers had been ignored, as in the case of Dr. Alice Stewart. Gayle Greene's *The Woman Who Knew Too Much* explores the lifelong repression of Stewart's important radiation research (2001). The world knows of Rachel Carson's warnings about DDT in *Silent Spring*, but she also cautioned strongly against the dangers of ionizing radiation and its bioaccumulative impacts (2002). Additionally, there has been a gender gap favoring men in the perception of nuclear technology (Solomon et al. 1989). As we have seen in the work of Kimura, Folkers, Hutner, and others, the concerns expressed by Japanese women about radiation safety are often labeled as "radiophobic." We must be careful to consider the ideological underpinnings of this term, as there is a patriarchal history of marking women as hysterical and scientifically uninformed as a way of silencing their oppositional viewpoints (Folkers 2017) (Hutner and Folkers 2018). As Kendra Ulrich's work shows, the unequal impacts of radiation disaster(s) on women and children in terms of domestic violence, economics, psychosocial, and family structures ("atomic divorce") must be justly accounted for in considering nuclear energy safety and viability (Ulrich 2017). In Japan, 90 percent or more of the stakeholders and decision-makers in the nuclear village and government are men. As Mioko Smith, peace studies advocates, and stakeholders and delegates at the conference to ban the bomb at the UN state, women deserve an equal voice in nuclear energy, power, and waste decision-making.

Challenges and Barriers

Changing patriarchal power structures and social systems remains a challenging process, but Japanese women are being vocal. Activists such as Mioko Smith go before nuclear planning boards and address their politicians regularly, yet their viewpoints go unheeded. The nuclear village, both in Japan and across the world, remains a powerful entity. Since the bombing of Hiroshima and Nagasaki, women have fought against the use of nuclear power and nuclear weapons worldwide. Hibakusha, mothers for peace, antinuclear activists,

health professionals (such as Physicians for Social Responsibility), and scientists all state that nuclear weapons and nuclear power byproducts harm humans and threaten life on earth. Mothers and others argue that we have a moral responsibility to do no harm (or do as little harm as possible) to future generations. Nuclear radiation technology and its byproducts remain dangerous for hundreds of thousands of years and have long-term generational genetic impacts, and we have yet to find a means to safely dispose of radioactive waste. Addressing and solving truly safe waste disposal must be a focal point for the future of this industry. Many nuclear reactors today are situated in geologically unstable locations and near large population centers; they pollute communities and release harmful amounts of ionizing radiation and toxic contaminants. These releases potentially increase children's cancer rates and a range of other diseases in people of all ages—but especially women and children (Tilman, Alfred R., personal interview with Heidi Hutner, June 21, 2017; Ian Fairlie 2014). Nuclear accidents happen, yet nations are not prepared for such accidents. The Fukushima catastrophe is ongoing with no end in sight. The continued work of women scientists, historians, and advocacy groups may help with educating and raising awareness. Today, gender and racial inequities around nuclear radiation are being considered by the United Nations as a result of women's efforts. Until we understand how to safely manage radiation waste produced by power plants and bomb factories, until we know how to prevent and safely manage nuclear accidents, we must consider taking the precautionary path. In terms of nuclear energy consumption, women activists such as Mioko Smith and her large Japanese cohort suggest that we use alternative, safer means to produce power—wind, solar, geothermal, and hydropower. For Japan and all nuclear nations, embracing a precautionary approach to energy use requires a shift in thinking about our ethical responsibility to protect future generations. In this environmental and sustainable rethinking, an ecofeminist philosophical and environmental justice ethic may be helpful. Ecofeminist proponents suggest that all beings—women, children, the underprivileged, and people of all racial backgrounds—deserve a seat at the political, energy, and environmental decision-making table. Environmental historian and ecofeminist scholar Carolyn Merchant calls this shared politics a "partnership ethic" (2013). Knowing human and biotic health systems are interconnected, the needs of all biotic life must be equally considered. If we poison the land, water, and air, we poison the human population as well. As this study of women and Fukushima has shown, the safety of women and children must be given (at least) equal consideration in the politics of nuclear radiation and energy in Japan. The denial of women's access to energy policymaking in Japan marks nuclear power as a feminist issue.

Note

1. A sievert, or SI, is the unit of radiation defined as producing the same biologic effect of high energy X-rays. One sievert is equivalent to 100 rem. 1 sievert, if absorbed all at once, will cause severe illness; 8 sieverts will cause death. Japan's allowable safety limits have been set to millisieverts (mSv). Twenty mSv and under are now considered officially safe by the Japanese government for long-term exposure; although prior to the nuclear accident, that number had been 1 mSv. According to *Physicians for Social Responsibility*, 20 millisieverts is equivalent to one thousand chest X-rays per year, or three chest X-rays every day per year. Exposure to 20 millisieverts over a lifetime will produce cancer in one in every six people (Helfand et al. 2011). Dr. Alice Stewart, the British epidemiologist, discovered that a single X-ray to the womb doubled the fetus' chance of acquiring cancer as a child (in the 1950s); she argued there is no safe dose of radiation (Greene 1999).

References

A2-B-C. 2013. Film. Directed by Nash, I. T. Tokyo: A2-B-C Steering Committee.

Alexis-Martin, B. 2015. The Chernobyl Necklace: The Psychosocial Experiences of Female Radiation Emergency Survivors. *Belgeo*. Revue belge de géographie (1).

Brent, R. 2008. Pregnancy and Radiation Exposure. *Mclean, Virginia: Health Physics Society*.

Carson, R., E.O. Wilson, and L. Lear. 2002. *Silent Spring*. Boston: Houghton Mifflin Harcourt.

Fairlie, I. 2014. Hypothesis to Explain Childhood Cancers Near Nuclear Power Plans. *Journal of Environmental Radioactivity* 133: 10–17.

Folkers, C. 2017. Fukushima Catastrophe at 6: Normalizing Radiation Exposure Demeans Women and Kids and Risks Their Health. *Counterpunch*. https://www.counterpunch.org/2017/03/06/fukushima-catastrophe-at-6-normalizing-radiation-exposure-demeans-women-and-kids-and-risks-their-health/. Accessed 20 June 2017.

Greene, G. 1999. *The Woman Who Knew Too Much: Alice Stewart and the Secrets of Radiation*. Ann Arbor: University of Michigan Press.

Helfand, I., D. Richardson, and M. Resnikoff. 2011. Physicians for Social Responsibility Deeply Concerned About Reports of Increased Radioactivity in Food Supply. Physicians for Social Responsibility. *Physicians for Social Responsibility*. http://www.psr.org/news-events/press-releases/psr-concerned-about-reports-increased-radioactivity-food-supply.html. Last Modified 23 March.

Higuchi, T. 2008. An Environmental Origin of Antinuclear Activism in Japan, 1954–1963: The Government, the Grassroots Movement, and the Politics of Risk. *Peace & Change* 33: 333–367.

Hutner, H. 2012. In Japan, A Mother's Movement Against Nuclear Power. *Yes! Magazine.* http://www.yesmagazine.org/peace-justice/in-japan-a-mothers-movement-against-nuclear-power. Accessed 20 June 2017.

———. 2015a. Aileen Mioko Smith, Anti-Nuclear Feminist. *Ms. Magazine Blog*. http://msmagazine.com/blog/2015/03/26/aileen-mioko-smith-anti-nuclear-feminist/. Accessed 20 June 2017.

———. 2015b. Invisible Victims. *Ms Magazine.*

———. 2017. The Grieving Landscape: Homes and Wombs Do Not Protect. In *Doom With A View,* Eds. K. Iverson & E.J. Perry.

———. 2018. Mothers, Gender, and the Fukushima Nuclear Disaster. In *From The Garden*, ed. S. Sloan and M.C. Oxford. Oxford: Oxford University Press.

Hutner, H. and C. Folkers. 2018. *Radiophobia* (Manuscript in Progress).

Jacobs, R. 2013. Social Fallout: Marginalization after the Fukushima Nuclear Meltdown. *Environment* 12(46).

Kimura, A.H. 2016. *Radiation Brain Moms and Citizen Scientists: The Gender Politics of Food Contamination After Fukushima*. Durham: Duke University Press.

Kingston, J. 2013. Japan's Nuclear Village. *Critical Issues in Contemporary Japan* 107.

Makhijani, A. 2008. *The Use of Reference Man in Radiation Protection Standards and Guidance With Recommendations for Change*. *Takoma Park*: *Institute for Energy and Environmental Research*.

Mccollough, C.H., B.A. Schueler, T.D. Atwell, N.N. Braun, D.M. Regner, D.L. Brown, and A.J. Leroy. 2007. Radiation Exposure and Pregnancy: When Should We Be Concerned? *Radiographics* 27: 909–917.

Merchant, C. 2013. *Partnership. Reinventing Eden: The Fate of Nature in Western Culture*. New York: Routledge.

Mousseau, T.A., A.P. Moller, A. Bonisoli-Alquati, and G. Rudolfsen. 2011. Chernobyl Birds Have Smaller Brains. *PLoS One* 6: e16862.

Murphy, S.M. 2014. Grassroots Democrats and the Japanese State After Fukushima. *Japanese Political Science Review* 2: 19–37.

Ogawa, A. 2013. Young Precariat at the Forefront: Anti-Nuclear Rallies in Post-Fukushima Japan. *Inter-Asia Cultural Studies* 14: 317–326.

Olson, M. 2012. Atomic Radiation Is More Harmful to Women. *Nuclear Information and Resource Service.*

———. 2014. Gender Matters in the Atomic Age. In *Crisis Without End: The Medical and Ecological Consequences of the Fukushima Nuclear Catastrophe*, ed. H. Caldicott. New York: The New Press.

Slater, D. H. 2011. Fukushima Women Against Nuclear Power: Finding a Voice From Tohoku. *The Asia-Pacific Journal: Japan Focus* 117.

Slater, D.H., Rika Morioka, and Haruka Danzuka. 2014. Micro-Politics of Radiation: Young Mothers Looking for a Voice in Post-3.11 Fukushima. *Critical Asian Studies* 46 (3): 485–508.

Smith, W., and A.M. Smith. 1975. *Minamata: The Story of the Poisoning of a City, and the People Who Choose to Carry the Burden of Courage*. New York: Alskog-Sensorium Books, Holt, Rinehart and Winston.

Solomon, L.S., D. Tomaskovic-Devey, and B.J. Risman. 1989. The Gender Gap and Nuclear Power: Attitudes in a Politicized Environment. *Sex Roles* 21: 401–414.

Swerdlow, A. 1993. *Women Strike for Peace: Traditional Motherhood and Radical Politics in the 1960s*. Chicago: University of Chicago Press.

Ulrich, K. 2017. *Unequal Impact: Women and Children's Human Rights Violations and the Fukushima Disaster.* March 2017 ed. Greenpeace Japan.

Wo, J.Y., and A.N. Viswanathan. 2009. Impact of Radiotherapy on Fertility, Pregnancy, and Neonatal Outcomes in Female Cancer Patients. *International Journal of Radiation Oncology, Biology, Physics* 73: 1304–1312.

Women of Fukushima. 2012. Film. Directed by Johanssen, P.

15

Emerging Social Movements for Sustainability: Understanding and Scaling Up Upcycling in the UK

Kyungeun Sung, Tim Cooper, and Sarah Kettley

Background

Upcycling is the creation or modification of a product from used materials and components or products which are of equal or higher quality or value than the compositional elements (Sung et al. 2014; Sung 2017). It is an umbrella concept which incorporates "creative" repair, reuse, refurbishment, upgrade, and much more.

Upcycled products vary in type and may take the form of "creative" repair (Fig. 15.1), refurbishment (Fig. 15.2), and reuse (Figs. 15.3 and 15.4). Examples include used clothing and accessories that have been redesigned and remade into new products. The upcycling of such items is sometimes deliberately made apparent, such as clothing repaired with decorative darning and used footwear that is decorated. Rugs, dolls, and soft furnishings such as cushions may be made from used clothing and other fabrics. Jewellery has been made from used pieces of metal, plastic, and fabrics, often in a steampunk style, and clocks have been made from used wheels,

K. Sung (✉)
De Montfort University, Leicester, Leicestershire, UK

T. Cooper
Nottingham Trent University, Nottingham, Nottinghamshire, UK

S. Kettley
Edinburgh College of Art, Edinburgh, UK

R. Brinkmann, S. J. Garren (eds.), *The Palgrave Handbook of Sustainability*,
https://doi.org/10.1007/978-3-319-71389-2_15

Fig. 15.1 Upcycling example one: Sock before and after decorative darning (Source: McLaren 2017)

Fig. 15.2 Upcycling example two: Display cabinet before and after upcycling (From interviewee 1)

books, records, appliances, and various other objects. Many used items of furniture are re-upholstered, repainted, and redecorated. Upcycled kitchenware items include bowls made from vinyl records, cups and plates made from glass bottles, and cutlery organisers made from metal tins and glass jars. Upcycled musical instruments include ukuleles from cigar boxes and guitars from old skateboards and oil cans. Sports items such as snowboards or surfing boards have been redecorated and bicycles upgraded with higher quality parts. Sheds, garden furniture, and planters have been made from reclaimed wood, including used pallets. The list goes on.

Fig. 15.3 Upcycling example three: Bird box and compost bins upcycled from reclaimed wood (From interviewee 2)

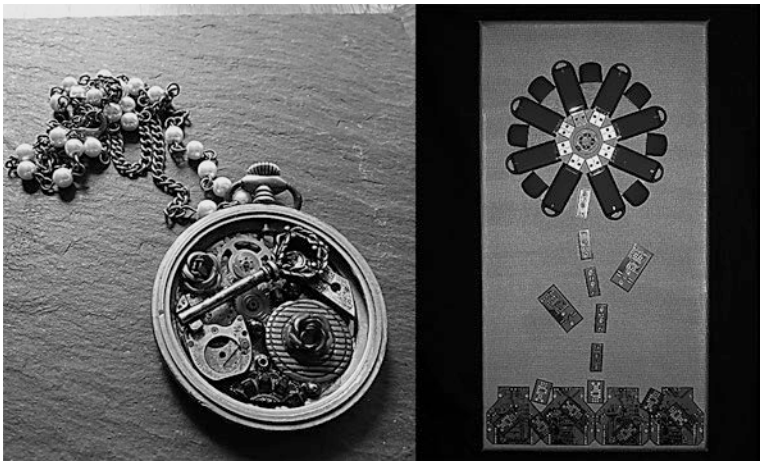


Fig. 15.4 Upcycling example four: Jewellery and wall decoration upcycled from metal and plastic pieces, and discarded USB sticks and computer components, respectively (From interviewee 3)

Upcycling has become a buzzword in the UK and other industrialised countries. Several television programs on upcycling have been produced, including *Kirstie's Fill Your House for Free* (Channel Four 2013), *Kevin's Supersized Salvage* (Channel Four 2014), and *Money for Nothing* (BBC One 2017). News articles on upcycling are increasingly common, practical upcycling books (typically linked to craft and hobbies, art and design, or do-it-yourself) have been published, and videos on upcycling uploaded onto YouTube. Anecdotal evidence suggests that the number of people who upcycle has increased; certainly, they have become more visible. Interest in upcycling appears linked to the contemporary "maker movement" (Anderson 2012; Lang 2013), readily available physical resources such as Hackspaces and Makerspaces (UK Hackspace Foundation 2015), and access to shared digital resources (e.g. Instructables, Etsy).

Upcycling is an example of emerging collective action by citizens that represents a new social movement, in that many people who engage in upcycling appear to regard it as a form of value-oriented activism that suggests an alternative to the dominant modes of production (based on virgin raw materials) and consumption (purchasing new products). As such, it fits amongst a range of social movements that have emerged since the late 1960s, not only in Europe and the USA but in Latin America and South Asia (Rajagopal 2000), to promote environmental sustainability, peace, gender equality, and community (Lynch 1998; Hassanein 2003; Lockie 2004; Carty and Onyett 2006). Dominated by the middle class (Spencer 1995), these new social movements typically incorporate universal values and goals, focus on identity politics and cultural struggles (Toke 2011), and pursue an agenda of comprehensive societal change (Blühdorn 2006). They differ from old social movements, in that the latter focused on class-based issues at the structural level (Carty and Onyett 2006) and were more materially based and institutionalised (Toke 2011). The generic term "social movements" is used in this chapter and understood as value-oriented movements (Lynch 1998) by civil society that use activism (Smith et al. 2014) in order to bring about change by transforming values, lifestyles, and symbols (Melucci 1985). As a means to the end, they suggest and deploy alternative conceptions, frameworks, or practices to unsettle or challenge the dominant cultural meanings, patterns of thoughts, order of things, and practices (Escobar 1998; Boggs 1989; Hargreaves 2002).

Contemporary research on social movements has investigated a variety of initiatives for environmental sustainability, including the degrowth movement (Schneider et al. 2010; Demaria, et al. 2013), slow city movement (Pink 2008), campaigns against toxic waste (Ford 2003) and tourism (Kousis 2000), socially responsible investment (Friedman and Miles 2001), environmental organisations (Brulle 2000; Carruthers and Rodriguez 2009), sustainable food production and consumption (Tovey 1997; Pietrykowski 2004; Alkon 2008; Morgan 2009; Starr 2010; Alkon and McCullen 2011; Sbicca 2012), and climate activism in the form of campaigns and climate camps (North 2011) and the associated transition town network and low carbon communities (Haxeltine and Seyfang 2009; Connors and McDonald 2010; Bailey et al. 2010; Smith 2011). Overall, the existing body of research literature has paid attention mainly to the relatively well-organised and long-established movements. Less attention has been paid to emerging collective actions by citizens. This chapter, therefore, aims to provide analysis of one such case, the upcycling movement in the UK, and consider its potential prospects.

Upcycling is both a form of alternative consumption in which people can engage (Albinsson and Yasanthi Perera 2012) and also a form of alternative

production that environmentally conscious entrepreneurs can utilise (e.g. Sung and Cooper 2015). Within the context of increased product longevity (Cooper 2010), it enables a reduction in the use of raw materials by extending the lifetime of used materials, components, and products, thereby increasing material efficiency and reducing industrial energy consumption (Allwood et al. 2011), which ultimately contributes to lower greenhouse gas emissions. It also reduces solid waste (or, at least, delays the addition of waste to landfill) (Bramston and Maycroft 2013; Zhuo and Levendis 2014). Thus, if scaled up to a meaningful level through appropriate interventions (Van den Bosch 2010), upcycling could, in theory, contribute significantly to preventing environmental harm.

The research underlying the case study reported in this chapter investigated the collective activity of upcycling in the UK from a behaviour perspective. More specifically, it drew upon, and adds to, design for sustainable behaviour, a strand of design research that aims to reduce the environmental and social impacts of products, services, and systems by influencing human behaviour (Bhamra and Lilley 2015). The focus of the research was on identifying different approaches to upcycling and on the context and underlying factors that influence upcycling behaviour. On the basis of this, design and policy interventions for scaling up upcycling were developed.

Case Study

The UK is legally obliged to reduce its greenhouse gas emissions by at least 80 per cent from 1990 levels by 2050 (UK Government 2015). As part of the Government's commitment to achieving this target, the Research Councils UK (RCUK) established six End Use Energy Demand centres in 2013 within its Energy Programme (EUED 2015). One of these was the Centre for Industrial Energy, Materials and Products (CIE-MAP), which conducts research on opportunities along the product supply chain to deliver reductions in materials and energy consumption in order to achieve lower carbon emissions (CIE-MAP 2015).

This chapter draws upon research on upcycling that was undertaken by CIE-MAP on the basis that it represents an opportunity to reduce materials and energy consumption (Sung 2017). The challenge is the marginal or "niche" status of upcycling in the UK at the current time. A key question, therefore, is how to scale up this movement such that upcycling becomes a mainstream activity by households and across different industries and has a bigger impact. The aim of the research was thus to explore actionable strate-

gies for scaling up the amount of upcycling undertaken in the UK. The central question was how households (and other relevant actors) could be influenced through appropriate interventions to increase the amount of upcycling undertaken such that it would make a significant contribution to sustainable production and consumption in the UK. Three specific objectives were identified: to gain insights into current upcycling behaviour in the UK, to identify the key factors influencing upcycling behaviour, and to develop design and policy interventions for scaling up upcycling.

In order to meet the first two of these objectives, a case study was used; case studies offer a means to investigate a contemporary phenomenon in-depth and within its real-world context by collecting multiple evidences (Yin 2013). For the data collection, semi-structured interviews were undertaken and an internet-based survey was conducted. Semi-structured interviews were selected as these allow flexibility in the order and wording of questions (Robson 2011; Bryman 2012) and the ability to probe when necessary (Barriball and While 1994). An internet-based survey was selected since it is able to reach large number of people within a relatively short time at relatively low cost (Fink 2012). In order to meet the first objective (gaining insights into upcycling behaviour in the UK), interviews explored how upcycling was undertaken (e.g. with what materials, when, where, with whom) and why it was undertaken (e.g. perceived benefits, attitudes, perceived behaviour control). In order to meet the second objective (identifying key factors influencing upcycling), a survey collected quantitative evidence to explain which factors determine upcycling behaviour, using a bigger sample.

In both studies, non-probability, purposive sampling was used. As the interviews asked about how and why people upcycle items, the target was UK-based consumers with practical upcycling experience. As the survey asked why people do or do not upcycle, the chosen target sample was "makers" in the UK, potentially anyone interested in making, crafting, hacking, knitting, sewing, scrap-booking, beading, cross-stitching, baking, or gardening (Anderson 2012), who were considered more likely to be aware of upcycling. For the recruitment of interviewees, an advertisement was posted on Google Groups and web fora of selected Hackspaces and Makerspaces, open workshops that provide local communities with access to tools, materials, and expertise for crafting, making, hacking, fixing, and maintenance (UK Hackspace Foundation 2015). To access potential survey respondents, the online questionnaire was shared on websites identified by the interview participants as ones that they visit on a regular basis for upcycling and by an internet search of relevant organisations and initiatives (e.g. Arduino forum, Craftster, Etsy, iFixit, Instructables, thingiverse).

A total of 23 people participated in the interviews, which took place between April and July 2014. Interviewees varied in age (from 24 to 66), nationality (17 British and 6 non-British), and gender (15 males and 8 females) and were based in nine different towns or cities. The interviews, which lasted between 30 and 90 minutes, were audio-recorded, transcribed, and analysed using QSR NVivo 10 Software. Thematic analysis, a general and flexible approach for analysing qualitative data based on coding (Braun and Clarke 2006; Bryman 2012; Robson 2011), was used, with each transcript examined line by line and coded. A total of 122 British residents responded to the survey between June and July 2015. Respondents were from all regions of the UK excluding Northern Ireland. They varied in age (18 per cent were under 30, 52 per cent between 30 and 49, and 30 per cent 50 or over) and gender (48 per cent male and 52 per cent female). The overwhelming majority were British (90 per cent). The responses were analysed by employing descriptive statistics, correlation analysis (Spearman's Rank Order Correlation), logistic regression, and non-parametric statistics for comparing groups (Mann-Whitney U Test and Kruskal-Wallis H Test) (Pallant 2013) using SPSS (Statistical Package for the Social Sciences) version 22.0.

The theoretical underpinning of questions on the factors influencing upcycling was a social psychology approach to understanding behaviour. More specifically, Triandis' Theory of Interpersonal Behaviour (Triandis 1977; Gagnon, et al. 2003, 2006) was used, due to its comprehensive nature and wide applicability (Jackson 2005; Martiskainen 2007; Sung 2017).

Findings

Findings from the study revealed a range of perspectives on the upcycling movement in terms of how people approach upcycling, the context in which it is undertaken, and factors influencing upcycling behaviour. In explaining how people approach upcycling, for example, the materials used for upcycling were most typically wood and textiles, people acquired the materials through online platforms such as eBay or Freegle, the criteria they used for selecting them were quality and value, and upcycled products were typically used in the upcycler's own home.

Regarding the context in which upcycling was undertaken, interviewees described the time of day when they considered upcycling suitable, how often they upcycled, where they undertook upcycling, and with whom, if anyone, they upcycled. Upcyclers did not undertake upcycling at any particular time, the frequency would depend on the particular project, and the location was typically the living room at their home.

Factors influencing upcycling behaviour were classified into the benefits that upcyclers obtain, the social factors they consider relevant, emotions attached to upcycling, whether they undertake any similar activities (or have done in the past), and any facilitating conditions or barriers that they have encountered. Benefits to upcyclers might be economic (savings in cost), environmental (reducing waste), psychological (feeling good), and sociocultural (recognition and appreciation from others). Social factors would include social norms such as being environmentally conscious, roles such as being someone who "makes do and mends", and self-concepts such as identification as an environmentalist. Upcyclers might feel a range of emotions, both positive and negative, ranging from frustration to excitement. Undertaking similar activities such as arts and crafts, whether currently or in childhood, was sometimes reported as prompting an interest in upcycling. Finally, facilitating conditions, such as access to tools, and barriers encountered, such as a lack of appropriate facilities, were important.

The survey results were explored to consider how different factors are related to each other, which factors are key determinants of upcycling, and whether demographic factors are influential. For example, analysis of the data using descriptive statistics revealed which benefits were important (e.g. a sense of fun) and which "role beliefs" were recognised (e.g. a role in their community). Analysis of relationships between factors (by Spearman's correlation) showed how potential determinants of upcycling such as the availability of materials or intention to upcycle are correlated with the frequency of upcycling. Key factors to explain upcycling were identified (through logistic regression analysis) and the results showed the importance of positive attitudes towards upcycling as one of the key determinants. Use of other statistical tests (Mann-Whitney U Test and Kruskal-Wallis H Test) revealed group differences based on sociodemographic characteristics such as gender, age, and occupation: for example, women reported higher scores than men in intention to upcycle.

Developing Interventions

The main findings from the case study were synthesised to determine the target population for expanding the upcycling movement and to develop a general approach to potential interventions. One of the target population demographic groups identified was people aged 30 or older, while an important approach to interventions was to focus on building more positive attitudes towards upcycling. The behavioural insights became the base information upon which to

formulate intervention strategies for scaling up the upcycling movement; this included organising community-based family events and workshops and training sessions to raise awareness of upcycling and build positive attitudes.

Potential intervention strategies were explored and discussed through a questionnaire and workshop with a group of 25 British experts in environmental policies, behaviour change, sustainable transitions, sustainable development, social innovation, or sustainable design. The results suggested which interventions were considered to have the greatest importance and feasibility, which actors are most suited to implement them, and how they should be implemented. Interventions with both importance and feasibility included new services to provide used materials more effectively, the actors considered most suited to implementing an intervention such as improved materials provision were waste companies and charity shops, and the means of implementing the interventions included a focus on providing access to wood and textiles and better-quality information. This stage of the research concluded by developing a prioritised list of interventions for the short term and long term, with suitable actors identified in each case.

Lessons Learnt and Challenges

This case study on the contemporary upcycling movement suggests how design research, in the form of design for sustainable behaviour, can contribute to understanding an emerging social movement and identify design and policy interventions that could enable it to expand. It confirms that designers, with their focus on (re)solving problems and suggesting solutions, offer distinctive skills that complement those of other disciplines in addressing environmental and social problems. In particular, the study demonstrated how design practitioners and researchers could utilise behaviour models, in both qualitative and quantitative research, in order to explore how to influence behaviour through design (i.e. design for sustainable behaviour). It showed how design research can generate proposals for influencing behaviour beyond traditional design interventions based on product-user interactions such as energy-saving use options on dishwashers, printers, and washing machines or visual feedback such as that provided through smart meters. This extends standard forms of social research in that it suggests realistic paths for achieving "desirable futures" (Krippendorf 2005, 26–27).

The study has informed theoretical understanding of the upcycling movement: what it is, what drives it, and how to scale up. This knowledge and the proposals—especially interventions by different actors—could contribute to

the growth of upcycling as a social movement. More generally, it is based on a multidisciplinary case study that, by integrating design, psychology, sociology, and policy studies, progresses sustainability science (Kajikawa 2008).

The next stage could be to undertake action research (Reason and Bradbury 2001) and prototype the proposed interventions to scale up the upcycling movement, pilot them, and monitor the processes and outcomes. In the meantime, our hope is that dissemination of the results of this study will instigate and stimulate action by various actors. Coordinated efforts by actors at multiple levels (e.g. central government and inter-governmental organisations at macro-level, local authorities, companies and NGOs at meso-level, and individuals at micro-level) with a shared vision may be required to achieve effectiveness in scaling up the movement. Networks may be critical to sustaining the action (Bosco 2001) as they play a crucial role in constructing collective identity (Melucci 1996; Snow et al. 1980) and linking local activism across different contexts (Grugel 2002; Keck and Sikkink 2014; Taylor and Rupp 2002).

Upcycling is one emerging social movement amongst many. It is a means towards achieving sustainable development which itself is, in many ways, a social movement and one which demands both top-down and bottom-up approaches (Luke 2005); sustainability vision, plans, and public policies can only come to fruition through action by all actors (Wheeler 2000, de Molina 2013). In this respect, the bigger challenge that researchers and practitioners need to address is how to scale up this sustainable development movement.

Acknowledgements This work was funded by Nottingham Trent University with support from the RCUK Energy Programme's funding for the Centre for Industrial Energy, Materials and Products, grant reference EP/N022645/1. Data collection activities were partly funded by Design Research Society.

References

Albinsson, P.A., and B. Yasanthi Perera. 2012. Alternative Marketplaces in the 21st Century: Building Community Through Sharing Events. *Journal of Consumer Behaviour* 11 (4): 303–315.

Alkon, A.H. 2008. From Value to Values: Sustainable Consumption at Farmers Markets. *Agriculture and Human Values* 25 (4): 487–498.

Alkon, A.H., and C.G. McCullen. 2011. Whiteness and Farmers Markets: Performances, Perpetuations… Contestations? *Antipode* 43 (4): 937–959.

Allwood, J.M., M.F. Ashby, T.G. Gutowski, and E. Worrell. 2011. Material Efficiency: A White Paper. *Resources, Conservation and Recycling* 55 (3): 362–381.

Anderson, C. 2012. *Makers: The New Industrial Revolution*. London: Random House Business.

Bailey, I., R. Hopkins, and G. Wilson. 2010. Some Things Old, Some Things New: The Spatial Representations and Politics of Change of the Peak Oil Relocalisation Movement. *Geoforum* 41 (4): 595–605.

Barriball, K.L., and A. While. 1994. Collecting Data Using a Semi-structured Interview: A Discussion Paper. *Journal of Advanced Nursing* 19 (2): 328–335.

Bhamra, T., and D. Lilley. 2015. Introduction, IJSE Special Issue: Design for Sustainable Behaviour. *International Journal of Sustainable Engineering* 8 (3): 146–147.

Blühdorn, I. 2006. Self-experience in the Theme Park of Radical Action? Social Movements and Political Articulation in the Late-modern Condition. *European Journal of Social Theory* 9 (1): 23–42.

Boggs, C. 1989. *Social Movements and Political Power: Emerging Forms of Radicalism in The West*. Philadelphia: Temple University Press.

Bosco, F.J. 2001. Place, Space, Networks, and the Sustainability of Collective Action: The Madres de Plaza de Mayo. *Global Networks* 1 (4): 307–329.

Bramston, D., and N. Maycroft. 2013. Designing with Waste. In *Materials Experience: Fundamentals of Materials and Design*, ed. E. Karana, O. Pedgley, and V. Rognoli, 123–133. Oxford: Butterworth-Heinemann.

Braun, V., and V. Clarke. 2006. Using Thematic Analysis in Psychology. *Qualitative Research in Psychology* 3 (2): 77–101.

Brulle, R.J. 2000. *Agency, Democracy, and Nature: The US Environmental Movement from a Critical Theory Perspective*. Cambridge: MIT Press.

Bryman, A. 2012. *Social Research Methods*. 4th ed. New York: Oxford university press.

Carruthers, D., and P. Rodriguez. 2009. Mapuche Protest, Environmental Conflict and Social Movement Linkage in Chile. *Third World Quarterly* 30 (4): 743–760.

Carty, V., and J. Onyett. 2006. Protest, Cyberactivism and New Social Movements: The Reemergence of the Peace Movement Post 9/11. *Social Movement Studies* 5 (3): 229–249.

CIE-MAP. 2015. *About CIE-MAP*. http://ciemap.leeds.ac.uk/index.php/about/.

Connors, P., and P. McDonald. 2010. Transitioning Communities: Community, Participation and the Transition Town Movement. *Community Development Journal* 46 (4): 558–572.

Cooper, T., ed. 2010. *Longer Lasting Products*. Routledge: Abingdon.

De Molina, M.G. 2013. Agroecology and Politics. How to Get Sustainability? About the Necessity for Political Agroecology. *Agroecology and Sustainable Food Systems* 37 (1): 45–59.

Demaria, F., F. Schneider, F. Sekulova, and J. Martinez-Alier. 2013. What Is Degrowth? From an Activist Slogan to a Social Movement. *Environmental Values* 22 (2): 191–215.

Escobar, A. 1998. Whose Knowledge, Whose Nature? Biodiversity, Conservation, and the Political Ecology of Social Movements. *Journal of Political Ecology* 5 (1): 53–82.

EUED. 2015. *What Is EUED?* http://www.eued.ac.uk/whatiseued.
Fink, A. 2012. *How to Conduct Surveys: A Step-By-Step Guide*. 5th ed. London: Sage.
Ford, L.H. 2003. Challenging Global Environmental Governance: Social Movement Agency and Global Civil Society. *Global Environmental Politics* 3 (2): 120–134.
Friedman, A.L., and S. Miles. 2001. Socially Responsible Investment and Corporate Social and Environmental Reporting in the UK: An Exploratory Study. *The British Accounting Review* 33 (4): 523–548.
Gagnon, M., G. Godin, C. Gagné, J. Fortin, L. Lamothe, D. Reinharz, and A. Cloutier. 2003. An Adaptation of the Theory of Interpersonal Behaviour to the Study of Telemedicine Adoption by Physicians. *International Journal of Medical Informatics* 71 (2): 103–115.
Gagnon, M., E. Sánchez, and J. Pons. 2006. From Recommendation to Action: Psychosocial Factors Influencing Physician Intention to Use Health Technology Assessment (HTA) Recommendations. *Implementation Science* 1 (8): 5908–5901.
Grugel, J. 2002. *Democracy Without Borders: Transnationalisation and Conditionality in New Democracies*. London: Routledge.
Hargreaves, A. 2002. Sustainability of Educational Change: The Role of Social Geographies. *Journal of Educational Change* 3 (3–4): 189–214.
Hassanein, N. 2003. Practicing Food Democracy: A Pragmatic Politics of Transformation. *Journal of Rural Studies* 19 (1): 77–86.
Haxeltine, A., and G. Seyfang. 2009. *Transitions for the People: Theory and Practice of 'Transition' and 'Resilience' in The UK's Transition Movement*, Working Paper 134. Norwich: Tyndall Centre for Climate Change Research.
Jackson, T. 2005. *Motivating Sustainable Consumption: A Review of Evidence on Consumer Behaviour and Behavioural Change,* Report for Sustainable Development Research Network, University of Surrey: Centre for Environmental Strategy.
Kajikawa, Y. 2008. Research Core and Framework of Sustainability Science. *Sustainability Science* 3 (2): 215–239.
Keck, M.E., and K. Sikkink. 2014. *Activists Beyond Borders: Advocacy Networks in International Politics*. London: Cornell University Press.
Kousis, M. 2000. Tourism and the Environment: A Social Movements Perspective. *Annals of Tourism Research* 27 (2): 468–489.
Krippendorf, K. 2005. *The Semantic Turn: A New Foundation for Design*. Boca Raton: Taylor & Francis.
Lang, D. 2013. *Zero to Maker: Learn (Just Enough) to Make (Just About) Anything*. Sebastopol: Maker Media.
Lockie, S. 2004. Collective Agency, Non-human Causality and Environmental Social Movements: A Case Study of the Australian 'Landcare Movement'. *Journal of Sociology* 40 (1): 41–57.
Luke, T.W. 2005. Neither Sustainable Nor Development: Reconsidering Sustainability in Development. *Sustainable Development* 13 (4): 228–238.
Lynch, C. 1998. Social Movements and the Problem of Globalization. *Alternatives* 23 (2): 149–173.

Martiskainen, M. 2007. *Affecting Consumer Behaviour on Energy Demand* (Report). Brighton: Sussex Energy Group.

McLaren, A. 2017. *Decorative Darning*. http://www.angharadmclaren.co.uk/#/weaving-darns/.

Melucci, A. 1985. The Symbolic Challenge of Contemporary Movements. *Social Research* 52 (4): 789–816.

———. 1996. *Challenging Codes: Collective Action in the Information Age*. Cambridge: Cambridge University Press.

Morgan, K. 2009. Feeding the City: The Challenge of Urban Food Planning. *International Planning Studies* 14 (4): 341–348.

North, P. 2011. The Politics of Climate Activism in the UK: A Social Movement Analysis. *Environment and Planning A* 43 (7): 1581–1598.

Pallant, J. 2013. *SPSS Survival Manual*. Maidenhead: McGraw-Hill Education.

Pietrykowski, B. 2004. You Are what You Eat: The Social Economy of the Slow Food Movement. *Review of Social Economy* 62 (3): 307–321.

Pink, S. 2008. Sense and Sustainability: The Case of the Slow City Movement. *Local Environment* 13 (2): 95–106.

Rajagopal, B. 2000. From Resistance to Renewal: The Third World, Social Movements, and the Expansion of International Institutions. *Harvard International Law Journal* 41 (2): 529–578.

Reason, P., and H. Bradbury. 2001. *Handbook of Action Research: Participative Inquiry and Practice*. London: Sage.

Robson, C. 2011. *Real World Research: A Resource for Social Scientists and Practitioner Researchers*. 3rd ed. Chichester: John Wiley & Sons.

Sbicca, J. 2012. Growing Food Justice by Planting an Anti-oppression Foundation: Opportunities and Obstacles for a Budding Social Movement. *Agriculture and Human Values* 29 (4): 455–466.

Schneider, F., G. Kallis, and J. Martinez-Alier. 2010. Crisis or Opportunity? Economic Degrowth for Social Equity and Ecological Sustainability. Introduction to this Special Issue. *Journal of Cleaner Production* 18 (6): 511–518.

Smith, A. 2011. The Transition Town Network: A Review of Current Evolutions and Renaissance. *Social Movement Studies* 10 (1): 99–105.

Smith, A., M. Fressoli, and H. Thomas. 2014. Grassroots Innovation Movements: Challenges and Contributions. *Journal of Cleaner Production* 63: 114–124.

Snow, D.A., L.A. Zurcher Jr., and S. Ekland-Olson. 1980. Social Networks and Social Movements: A Microstructural Approach to Differential Recruitment. *American Sociological Review* 45 (5): 787–801.

Spencer, B. 1995. Old and New Social Movements as Learning Sites: Greening Labor Unions and Unionizing the Greens. *Adult Education Quarterly* 46 (1): 31–42.

Starr, A. 2010. Local Food: A Social Movement? *Cultural Studies? Critical Methodologies* 10 (6): 479–490.

Sung, K. 2017. *Sustainable Production and Consumption by Upcycling: Understanding and Scaling Up Niche Environmentally Significant Behaviour*. PhD thesis, Nottingham Trent University, Nottingham.

Sung, K., and T. Cooper. 2015. Sarah Turner–Eco-artist and Designer Through Craft-based Upcycling. *Craft Research* 6 (1): 113–122.

Sung, K., T. Cooper, and S. Kettley. 2014. Individual Upcycling Practice: Exploring the Possible Determinants of Upcycling Based on a Literature Review. In *Sustainable Innovation 2014 Conference, Copenhagen*, 237–244. Farnham: The Centre for Sustainable Design.

Taylor, V., and L. Rupp. 2002. Loving Internationalism: The Emotion Culture of Transnational Women's Organizations, 1888–1945. *Mobilization: An International Quarterly* 7 (2): 141–158.

Toke, D. 2011. Ecological Modernisation, Social Movements and Renewable Energy. *Environmental Politics* 20 (1): 60–77.

Tovey, H. 1997. Food, Environmentalism and Rural Sociology: On the Organic Farming Movement in Ireland. *Sociologia Ruralis* 37 (1): 21–37.

Triandis, H.C. 1977. *Interpersonal Behavior*. Monterey: Brooks/Cole Publishing Company.

UK Government. 2015. *2010 to 2015 Government Policy: Greenhouse Gas Emissions*. https://www.gov.uk/government/publications/2010-to-2015-government-policy- greenhouse-gas-emissions/2010-to-2015-government-policy-greenhouse-gas- emissions#issue.

UK Hackspace Foundation. 2015. *UK Hackspace Foundation*. http://www.hackspace.org.uk/view/Main_Page.

Van den Bosch, S.J.M. 2010. *Transition Experiments: Exploring Societal Changes Towards Sustainability*. PhD thesis, Erasmus University Rotterdam, Rotterdam.

Wheeler, S.M. 2000. Planning for Metropolitan Sustainability. *Journal of Planning Education and Research* 20 (2): 133–145.

Yin, R.K. 2013. *Case Study Research: Design and Methods*. London: Sage.

Zhuo, C., and Y.A. Levendis. 2014. Upcycling Waste Plastics into Carbon Nanomaterials: A Review. *Journal of Applied Polymer Science* 131 (4): 1–14.

16

Urban Vulnerability of Waste Workers in Nigerian Cities: The Case of Aba, Nigeria

Thaddeus Chidi Nzeadibe and Friday Uchenna Ochege

Background

Goal 11 of the post-2015 development agenda focuses on urban areas where a majority of the global population lives and works. Since the turn of the twenty-first century, there has been a surge of interest in social sustainability of cities in urban planning policy and practice. While Goal 8 of the sustainable development goals (SDGs) seeks to promote sustained, inclusive and sustainable economic growth, full and productive employment, and decent work for all, the informal economy of waste in African cities has been excluded from mainstream of urban governance and socio-economic processes. As a result, social sustainability of the informal waste trade has remained bleak. Despite the imprecise and fluid boundaries of the concept of social sustainability, we argue that some aspects of social sustainability such as quality of life, community well-being, and social recognition are relevant to the informal waste economy (Boström 2012).

The focus of this chapter is the informal waste management sector in cities of Nigeria wherein intense socio-political and ecological struggles, competitions, and contestations take place, thus representing a critical site of

T. C. Nzeadibe (✉)
Department of Geography, University of Nigeria, Nsukka, Nigeria

F. U. Ochege
Department of Geography and Environmental Management, University of Port Harcourt, Choba, Nigeria

R. Brinkmann, S. J. Garren (eds.), *The Palgrave Handbook of Sustainability*,
https://doi.org/10.1007/978-3-319-71389-2_16

contestation around urban citizenship (Fredericks 2014). It is also a ubiquitous phenomenon in African cities (Adama and Nzeadibe 2017). Thus, informal waste workers in addition to being active players in the urban economic space are also a distinct and often heterogeneous social group (Nzeadibe and Anyadike 2012). The informal waste economy comprises a wide range of individuals and groups, namely, waste pickers, scrap dealers, itinerant waste buyers (IWBs), informal collectors or cart pushers, middlemen, and micro and small enterprises (MSEs) who make a living from collection, recycling, and disposal of solid waste outside the state's regulatory sphere. Unfortunately, vulnerabilities abound in informal waste-based livelihoods. These vulnerabilities may be social, economic, and political and are often related to prevailing government policies and socio-environmental factors over which the people involved have limited or no control (Brata 2010).

Making a living in the informal waste economy is associated with deprivations, threats to well-being, struggles and socio-political contestations for right to garbage, tensions and competitions for survival, cultivation and maintenance of social networks, agency, and collective organizing, all of which determine or codetermine sustenance of livelihoods and amalgamated toward overcoming some of the vulnerabilities (Lindell 2010; Nzeadibe and Mbah 2015). Vulnerability, on the other hand, describes a connection between social, economic, and ecological conditions to which individuals or communities are often subjected to and which they have limited or no control over. This chapter looks at vulnerability conditions of the informal waste economy in Nigerian cities as the converse of sustainable well-being conditions (Nzeadibe et al. 2012; Nzeadibe and Mbah 2015), the latter being a cocktail of feelings (contentment, joy, satisfaction) and functions (competence, self-esteem, worthwhileness) (The New Economics Foundation 2012, 6). Placing these in the context of external opportunities (work, social connectedness, trust in others, democratic involvement), and personal propensities (health, resilience, optimism, diversity of experiences) gives a sense of flourishing and competence (O'Riordan 2013).

Thus, the term vulnerability presupposes a condition in which people face a high risk of experiencing serious forms of deprivation that threaten their well-being and a limited capacity to cope with those threats (Schütte 2006). Vulnerability of livelihoods in informal sector activities is often related to prevailing government policies and socio-environmental factors (Brata 2010). The need to investigate the livelihood vulnerabilities in the informal waste management sector in Aba urban area motivated this research.

Instructively, informal waste-based livelihood has attracted a modicum of attention in studies on developed societies (Gutberlet et al. 2009) and developing countries (Wilson et al. 2006; Rouse and Ali 2001; Didero

2012). However, this chapter seeks to draw attention to urban vulnerability of informal waste work rather than sustainability *per se* as this has been given significant attention in the literature in African cities in recent years (Nzeadibe 2013; Nzeadibe and Mbah 2015; Fahmi and Sutton 2006; Adama and Nzeadibe 2017; Schenck et al. 2017).

It is to be noted that in the city of Aba and elsewhere, the informal economy is not just about evading state regulation but about vulnerability and institutional exclusion (Meagher 2010). In the city of Aba in Abia State of Nigeria, a large and dynamic but often unacknowledged informal system of waste recycling involving mainly waste pickers and waste dealers is in existence (Nzeadibe et al. 2012). However, much still remains unknown about the informal workers, their activities, and their lives in urban Nigeria. In addition to availability of and access to waste, we note that a picker's livelihood may comprise good health, ability to work, and supportive social environment and infrastructure (Rouse and Ali 2001).

Given the profound centrality of waste recycling to the lives of the poor in low- and medium-income cities and that sustainability has become a central theme in development policy discourse and a focus of the debate over the environment-development interface in recent years (Nzeadibe and Mbah 2015), this chapter assesses the vulnerability of the livelihood of waste pickers and waste dealers in Aba in the belief that understanding the vulnerability of the livelihood can inform development and policy interventions to bring about sustainability of the informal waste work in Nigerian cities.

Case Study

About Aba, Nigeria

Aba is the commercial and industrial nerve center of Abia State, southeastern Nigeria. This city provides goods and services to adjacent urban areas and international markets (Nwafor 2002). It is located between latitudes 5°2′N and 5°11′N and longitudes 7°18′E and 7°28′E (Fig. 16.1). The study area covers an estimated 95 km^2 (Uchegbu 2009). It includes the entire Aba North and Aba South Local Government Areas (LGAs) and parts of Osisioma and Ugwunagbo LGAs.

The population of Aba has been growing steadily since the first census of the study area in 1931. Between the 1931 and 1952/1953 censuses, the population of Aba increased fourfold from 13,000 to 58,000 (Okoye 1975, 2002). By 1953, Aba was classified among the urban centers in Eastern Nigeria with

Fig. 16.1 Aba urban area, Nigeria

50,000 or more inhabitants (East Central State of Nigeria 1972; Okoye 1975). In 1963, the population was 131,003 and ten years later 180,558 (Okorafor 1975). By 1991, the population of Aba had risen to 494,152 (National Population Commission 1991). As of 2006, the estimated population stood at 1,022,138 (Federal Republic of Nigeria 2009).

Aba is also a rapidly growing city in terms of concentration of socio-economic activities and general urban expansion. Based on the Abia State natural increase rate of 2.83 percent (Abia State of Nigeria 2005), the current population projection estimate of Aba is 1,389,401 indicating about 73 percent population growth from the last census year in 2006 and now. Its urban growth and development has been largely unplanned, resulting in various incompatible land uses in close proximity. With residential, industrial, and

commercial land juxtaposed, urban environmental problems such as noise, traffic congestion, air pollution, street hawking, and solid waste are rife.

Contextualizing Urban Vulnerability in Informal Waste Management

Waste management by informal sector groups is not a new phenomenon and its existence in Western cities of the past apparently suggested neither a state of anomie nor anomaly nor were they Hobbesian as a result of the operation of vibrant informal waste management (IWM) systems (Downs and Medina 2000). IWM was practiced in pre-industrial France, United States, and the United Kingdom and has largely died out in the developed countries since the twentieth century (Mayhew 1862; New York Times 1869; Perry 1978; Melosi 1981; Lieberherr-Gardiol 1996; Strasser 2000; Wilson 2007) although it appears to have resurfaced recently in Canadian cities of Victoria (Gutberlet et al. 2009), Calgary (Bender 2010), and St. John's Newfoundland (Porter 2015). It was reportedly an efficient resource recovery strategy in the United States and the dust yards of nineteenth-century London (New York Times 1869; Perry 1978; Velis et al. 2009). While IWM has today died out in most countries of the developed world, it remains prevalent in Africa (Nzeadibe 2009; Fahmi and Sutton 2006; Samson 2009; Adama and Nzeadibe 2017).

Unfortunately, the well-being of the informal workers has not been adequately considered in urban and environmental planning policies in African cities (Watson 2011; Nzeadibe et al. 2012; Nwosu et al. 2016). Thus, the informal waste economy in urban Africa has been a neglected and unfavored sector in African economies in terms of policy support and responses unlike what obtains in countries in Asia and Latin America (Medina 2007; Dias 2012). The sector is also not considered in social policy and poverty reduction strategy papers (PRSPs) of governments (Nigerian National Planning Commission 2004, 2007) or their development partners (International Monetary Fund 2007). More importantly, despite the new additions to the recent rebasing of the Nigerian economy, the waste economy is glaringly missing in the national income accounting process, and this has been a result of inadequate knowledge and official apathy toward the informal waste economy. This observation was echoed by the National Bureau of Statistics (2014, 24) and Kale (2014), who report that "the informal sector component for water supply, sewage and waste management is not included in this estimate due to lack of adequate data". The informal economy, almost by definition, does not routinely measure its performance, while data on activities and performance are notoriously scarce and often unreliable (Nzeadibe 2015). As a result of all these, the vulnerability of informal waste-based livelihoods has tended to persist in Nigerian cities.

Instructively, livelihoods of waste workers depend entirely on access to a continuous supply of solid waste and to a great degree on its continued poor management by authorities (Rouse and Ali 2001). Additionally, the informal waste sector is characterized by various forms of social exclusion such as non-recognition by authorities and non-participation in urban governance; lack of access to clean water, sanitation, and energy; and lack of access to social security, medical benefits, or housing. Gerometta et al. (2005) point out that social divisions in society are not new, yet the character of social divisions has changed. Social exclusion has become a preferred term in current debate, because it appears to be a broader and more dynamic concept than the notion of poverty. The notion of poverty focuses primarily on distributional issues, the lack of resources at the disposal of an individual or a household. In contrast, social exclusion focuses primarily on relational issues: inadequate social participation, limited social integration, and lack of power (Nzeadibe and Anyadike 2012). In some cases, activities of the informal waste sector are considered illegal (Nzeadibe and Anyadike 2010). These socially exclusionary tendencies and attempts at modernization of the SWM system, to make it more efficient, invariably displace the informal sector already in existence and tend to increase vulnerability of livelihoods in the informal waste sector.

Constructing Vulnerability Index of Waste Workers in Aba, Nigeria

In the planning of solid waste management in Nigerian cities, including Aba, account is usually not taken of informal sector waste workers (see, e.g., Nzeadibe 2009). Although these groups drive the recycling system, they often suffer social exclusion, and their activities are often considered illegal (Nzeadibe and Anyadike 2010). Social exclusion and non-participation in urban governance would seem to be major contributing factors to the vulnerability of livelihoods within the informal recycling system.

A study on social vulnerability of waste pickers has been carried out in India (Sarkar 2003) with little effort made in the work to provide approximate vulnerability index of the pickers. In order to make empirical estimates of the vulnerability of livelihoods of the waste pickers in Aba, a vulnerability index was constructed from an adaptation of studies in Sri Lanka (Fernando 2003, 2011), India (Dabir-Alai 2004), and Indonesia (Brata 2010). The estimates are based on extensive fieldwork carried out with a range of indicators that represent social conditions, assets, and actions of the study population. It is to be added also that the vulnerability scores calculated are city-specific.

While the indices are not absolute, they are intended to give an indication of the level of vulnerability of the pickers within the city. However, they may be adapted for use elsewhere.

Binary-Composite Index of Vulnerability of Waste Pickers

The binary-composite index of vulnerability of waste pickers is based on binary counts of vulnerability elements listed in Table 16.1. In this table, ten elements relating to vulnerability of waste pickers' livelihoods which required binary responses (i.e., Yes/No type answers) as contained in the original survey instrument were identified and tabulated. Since subjectivity and subjective well-being are inherent characteristics of vulnerability and quality of life (QoL) assessments, selected elements of vulnerability are based on the subjective view as has been applied elsewhere (Dabir-Alai 2004; Braga 2010). Distribution of respondents based on the binary-composite vulnerability index is given in Table 16.2.

Table 16.1 Elements of binary-composite vulnerability index of Aba waste pickers

Vulnerability elements	Binary value	Underlying justification
1. Membership of scavenger coop	No = 1, Yes = 2	More/less opportunity to improve bargaining power provided by association
2. Have alternative occupation	No = 1, Yes = 2	A job to fall back in cases of adversity
3. Major injury in the past six months	No = 1, Yes = 2	A major setback in waste picking activity
4. Harassment by police or local government officials	No = 1, Yes = 2	Unlikely/likely to feel threatened
5. Do you believe these health problems are work-related?	No = 1, Yes = 2	Perception of work-related health problems
6. Do you have formal education?	No = 1, Yes = 2	An important element which could influence other elements in seeking SL
7. Given the opportunity, would you like to continue your formal education?	No = 1, Yes = 2	Unlikely/likely to improve human capital
8. In the past six months, did you visit a health worker?	No = 1, Yes = 2	Opportunity to improve health status
9. If offered another job, will you stop picking waste?	No = 1, Yes = 2	Opportunity to exit waste picking and improve livelihood
10. Were you born in this city?	No = 1, Yes = 2	To establish residential status of picker
Vulnerability index =[(1)+(2)+(3)+(4)+(5)+(6)+(7)+(8)+(9)+(10)]		

Source: Nzeadibe et al (2012)

Table 16.2 Distribution of respondents based on binary-composite vulnerability elements

Elements	No. of respondents with score "1" (or vulnerable)	Percent of total respondents (n = 401)
1. Do not belong to a scavenger coop	365	91
2. Do not have alternative occupation	370	92
3. Had major injury in the past six months	161	40
4. Have been harassed by police or local govt. official	137	34
5. Don't believe these health problems are work-related	327	82
6. No formal education	14	3.5
7. Would not like to continue formal education if given the opportunity	93	23
8. Has not visited a health worker in the past six months	240	59
9. Will not stop picking waste if offered another job	79	20
10. Not born in the city	161	40

Source: Nzeadibe et al (2012)

Obstacles Encountered by Waste Dealers in Aba

In seeking to establish the vulnerability of livelihoods in the informal recycling system in Aba, the survey elicited information on obstacles faced by waste dealers in the pursuit of their livelihood. The major obstacles reported by the waste dealers themselves during the survey are presented as shown in Fig. 16.2.

Key informant interviews (KIIs) with selected major dealers revealed that inadequate finance and damage of goods in transit, especially bottles, are the two most important obstacles faced by waste dealers in Aba. These two factors combined account for more than half of the complaints reported in the survey. Police harassment/extortion and lack of motorable roads in Aba both account for about 15 percent of responses on the obstacles to the recycle trade. Indeed, these two later factors appear to contribute to the damage of the goods. For example, the bad roads in Aba lead to road accidents which often result in the destruction of the goods. Also, in order to evade extortionist policemen, the dealers sometimes ply very bad roads and this has consequences for the safety of their goods.

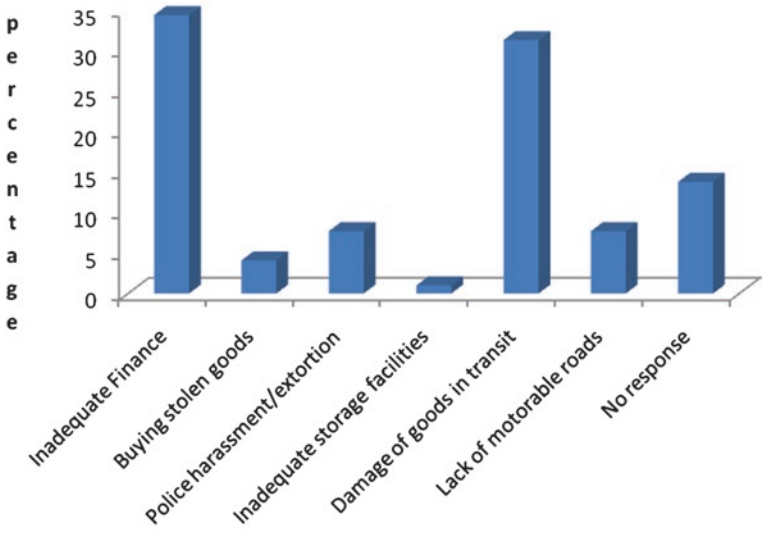


Fig. 16.2 Major obstacles encountered by waste dealers

When asked if the police and local government officials disturbed their business, over 50 percent of the waste dealers responded that they did not disturb them; about 35 percent indicated that they sometimes disturbed them; one percent responded that they always disturbed them. Table 16.3 presents responses of waste dealers on disturbance by police and local government officials. We probed about the profitability of their business; an overwhelming proportion of waste dealers (88.2 percent) responded that their business was profitable.

Locational Vulnerability Index (LVI) of Waste Pickers in Aba

This index relates to vulnerability of waste pickers given their spatial location in the city of Aba. It was obtained by applying the following equation:

$$\frac{\text{LVI} = \text{No of waste pickers / location}}{\text{Vulnerability score for each element}}$$

Table 16.3 Disturbance of waste dealers by government officials

Police and LG disturbance	%
No response	6.2
Never	57.9
Sometimes	34.9
Always	1.0
Total	**100**

Source: Nzeadibe and Mbah (2015)

Table 16.4 Locational vulnerability index (LVI) of waste pickers at Ariaria Market/Burrow pit site

Vulnerability elements	No. of respondents with score "1" (or vulnerable)	Locational vulnerability index	
1. Do not belong to a scavenger coop	365	0.38	
2. Do not have alternative occupation	370	0.37	
3. Had major injury In the past six months	161	0.85	
4. Have been harassed by police or local govt. official	137	1.00	
5. Don't believe these health problems are work-related	327	0.42	
6. No formal education	14	9.9	
7. Would not like to continue formal education if given the opportunity	93	1.48	
8. Has not visited a health worker in the past six months	240	0.58	
9. Will not stop picking waste if offered another job	79	1.75	
10. Not born in the city	**161**	0.38	
Total LV I			**17.03**
Mean LVI			**1.7**

The LVI of waste pickers for various points in the urban space of Aba was calculated. The locational vulnerability index of waste pickers at the largest waste dump in Aba, the Ariaria Market/Burrow pit site, is given in Table 16.4.

Implications of the LVI Values for Social Innovation in Waste Recycling

In many cities around the world, individuals and small groups have emerged to develop and implement solutions to some of their pressing social and economic challenges through what has been referred to as social innovation

(Gerometta et al. 2005). The general social rationale of social innovative initiatives is to promote inclusion into different spheres of society, while the political rationale is to give a voice to groups that have been traditionally absent from politics and politico-administrative system at the local and other institutional/spatial scales (Moulaert et al. 2005).

Development researchers seem to be in agreement that social innovation involves new strategies, concepts, ideas, and organizations that meet social needs (see, e.g., Gerometta et al. 2005). Moulaert et al. (2005) identify three core dimensions of social innovations as the satisfaction of human needs, changes in social relations especially with regard to governance, and an increase in the socio-political capability and access to resources.

In the social sciences, social innovation is often related to innovative solutions to poverty alleviation or social exclusion (Gerometta et al. 2005; Moulaert et al. 2005; Gutberlet 2010). The social entrepreneur provides a product or service fulfilling a social need. It may, thus, be argued that there is an unfulfilled social need in solid waste governance which the informal sector strives or has managed to satisfy (Ahmed and Ali 2004), often with the application of innovation, dexterity, and entrepreneurship (Nzeadibe and Ajaero 2011).

With regard to the locational vulnerability indices calculated above, it would be stated that waste pickers at the Ariaria/Burrow pit site are the least vulnerable of all the waste pickers in Aba. Their total LVI is 17.03, while the mean LVI is 1.7 and this is the largest LVI in the study area. What it means is that their high concentration at one location provides the pickers the critical mass to organize or prop up themselves during periods of adversity such as eviction resulting from modernization of the SWM system. They also tend to support one another through the operation of an informal thrift arrangement (*isusu*). In order to cope with the vicissitudes of the recycle trade, particularly exploitation by middlemen and harassment by authorities, some waste picker groups in Nigeria have attempted to band together to form and operate a cooperative or pressure group (Nzeadibe and Anyadike 2010).

Pickers that operate in isolated locations would tend to be more vulnerable as they often lack the market, safety net, and social support from fellow pickers and family members in times of trouble. It is also possible for them to organize among themselves to tackle their common problems and have voice in public policy and urban governance (Ezeibe et al. 2017). As has been shown elsewhere (Nzeadibe and Anyadike 2010), the formation and operation of a vibrant cooperative association by informal sector groups may be regarded as a form of social innovation. In this context, "there are also locally formed and adapted characteristics and social systems which appear to have enabled the

sector to tide over the vicissitudes of the recycle trade. Most prominent of these are a participatory socio-political organisation and networking among the informal waste workers, economic and socio-environmental contributions, and resilience in the face of unfavourable socio-economic and political climate" (Nzeadibe and Anyadike 2010, 1288). Social innovation, it has been argued, is the key to countering trends of social exclusion and to fostering social inclusion processes (Gerometta et al. 2005). There is therefore need for the informal waste sector in Aba to be socially innovative "as its survival depended on the adoption of new, 'internally-generated' ideas and governance arrangements" (Nzeadibe and Anyadike 2010, 1288).

Conclusion

This chapter has shown that informal waste workers are a vulnerable group in Nigerian cities. The vulnerabilities may be social, economic, and political and are often related to prevailing government policies and socio-environmental factors over which the people involved have limited or no control. However, the study argues that location can be a factor of pickers' vulnerability and that collective organizing and social innovation can be crucial to countering trends of exclusion. While noting the relevance of SDGs 8 and 11 to urban sustainability of livelihoods of informal waste workers, it is argued that development intervention should aim at achieving more inclusive cities as inclusion could be a strong factor in ensuring improved well-being and sustainability of the waste economy in Nigerian cities.

Acknowledgments Some aspects of this chapter were drawn from authors' previous research published in the following journals: *City, Culture and Society*; *Applied Research in Quality of Life*; *Geography Compass*; and *Review of African Political Economy*. These sources are gratefully acknowledged.

Further Reading

Abia State of Nigeria ASN. 2005. Abia State Economic Empowerment and Development Strategy. *Abia State Government Publication*. http://web.ng.undp.org/documents/SEEDS/Abia_State.pdf/. Accessed 14 June 2014

Adama, O., and T.C. Nzeadibe. 2017. *Dealing with Waste: Resource Recovery and Entrepreneurship in Informal Solid Waste Management in African Cities*. Trenton: Africa World Press.

Ahmed, S.A., and M. Ali. 2004. Partnerships for Solid Waste Management in Developing Countries: Linking Theories to Realities. *Habitat International* 28 (3): 467–479.

Bender, C. 2010. Informal Employment: Making a Living in Calgary. Final Report Calgary Homeless Foundation, Calgary, Canada. http://www.calgaryhomeless.com/users/folderdata/%7B5517DB85-3E01-4E58-B023-012D3EF6590A%7D/PanhandlingReport_SubmittedToCHF_Sept21_2010.pdf. Web Accessed 3 Aug 2011.

Boström, M. 2012. A Missing Pillar? Challenges in Theorizing and Practicing Social Sustainability: Introduction to the Special Issue. *Sustainability: Science, Practice, & Policy* 8 (1): 3–14.

Brata, A.G. 2010. Vulnerability of Urban Informal Sector: Street Vendors in Yogyakarta, Indonesia. *Theoretical and Empirical Researches in Urban Management* 5 (14): 47–58.

Dabir-Alai, P. 2004. *The Economics of Street Vending: An Empirical Framework for Measuring Vulnerability in Delhi in the Late 1990s*. Paper Presented at the EDGI and UNU-WIDER Conference, Unlocking Human Potential: Linking Informal and Formal Sectors, Helsinki, Finland, 17–18 September 2004.

Dias, S. 2012. *Waste and Development–Perspectives from the Ground*, Field Actions Science Reports, no. 6. pp. 1–6. http://factsreports.revues.org/1615. Accessed 6 Aug 2012.

Didero, M. 2012. Cairo's Informal Waste Collectors: A Multi-scale and Conflict Sensitive Perspective on Sustainable Livelihoods. *Erdkunde* 66 (1): 27–44.

Downs, M., and M. Medina. 2000. A Short History of Scavenging. *Comparative Civilizations Review* 42: 23–45.

East—Central State of Nigeria: Statistical Digest 1970. 1972. Official document No. 8, ECS, Enugu.

Ezeibe, C.C., T.C. Nzeadibe, A.N. Ali, C.U. Udeogu, C.F. Nwankwo, and C. Ogbodo. 2017. Work on Wheels: A Political Economy of Collective Organising in the Motorcycle Taxi Subsystem of Nigerian Cities. *International Development Planning Review* 39 (3): 249–273. https://doi.org/10.3828/idpr.2017.10.

Fahmi, W.S., and K. Sutton. 2006. Cairo's Zabaleen Garbage Recyclers: Multinationals' Takeover and State Relocation Plans. *Habitat International* 30 (4): 809–837.

Federal Republic of Nigeria Federal Republic of Nigeria Official Gazette 96, no. 2 2009. Abuja: Federal Government Printer.

Fernando, N. 2003. *A Measure of Urban Livelihood Vulnerability: The Case of Colombo*. Paper Submitted for the 9th International conference on Sri Lanka Studies, Matara, Sri Lanka, 28th–30th November 2003

———. 2011. Identifying the Urban Poor and Investigating Local Level Poverty Dynamics Through CBMS: A Case of Colombo. *Proceedings of the 2005 CBMS Network Meeting, 2005*. 689–714. http://www.pep-net.org/fileadmin/medias/pdf/files_events/4th_colombo/proceed/fernando.pdf. Accessed 26 Feb 2011

Fredericks, R. 2014. Vital Infrastructures of Trash in Dakar. *Comparative Studies of South Asia, Africa and the Middle East* 34 (3): 532–548. https://doi.org/10.1215/1089201X-2826085.

Gerometta, J., H. Häussermann, and G. Longo. 2005. Social Innovation and Civil Society in Urban Governance: Strategies for an Inclusive City. *Urban Studies* 42 (11): 2007–2021.

Gutberlet, J. 2010. Waste, Poverty and Recycling. *Waste Management* 30 (2): 171–173.

Gutberlet, J., C. Tremblay, E. Taylor, and N. Divakarannair. 2009. Who Are Our Informal Recyclers? An Inquiry to Uncover Crisis and Potential in Victoria, Canada. *Local Environment* 14 (8): 733–747.

International Monetary Fund. 2007. *Nigeria: Poverty Reduction Strategy Paper—Progress Report*, IMF Country Report No. 07/270. http://www.imf.org/external/pubs/ft/scr/2007/cr07270.pdf. Accessed 8 Sept 2013

Kale, Y. 2014. Measuring Better: Rebasing/Re-benchmarking of Nigeria's Gross Domestic Product. Presentation at the Lagos Business School Breakfast Meeting Lagos, 7 May.

Lieberherr-Gardiol, F. 1996. Waste, Waste Nothing but Waste – From 12th–19th Century Paris to 20th Century Developing Countries. In *Micro and Small Enterprises Involvement in Municipal Solid Waste Management in Developing Countries*, Workshop Report, UMP/SDC Collaborative Programme on Municipal Solid Waste Management in Low-income Countries, 14–18 October, Cairo, Egypt. pp. 42–47.

Lindell, I. 2010. Introduction: The Changing Politics of Informality – Collective Organising, Alliances and Scales of Engagement. In *Africa's Informal Workers: Collective Agency, Alliances and Transnational Organising in Urban Africa*, ed. I. Lindell, 1–30. London/Uppsala: Zed Books and the Nordic Africa Institute.

Mayhew, H. 1862. *London Labour and the London Poor*. London: Griffin, Bohn, and Company.

Meagher, K. 2010. *Identity Economics: Social Networks and the Informal Economy in Nigeria*. New York: James Currey.

———. 2013. *Unlocking the Informal Economy: A Literature Review on Linkages Between Formal and Informal Economies in Developing Countries,* WIEGO Working Paper No 27. Cambridge, MA: Women in Informal Employment: Globalizing and Organizing (WIEGO).

Medina, M. 2007. *The World's Scavengers: Salvaging for Sustainable Consumption and Production*. Lanham: AltaMira Press.

Melosi, M. 1981. *Garbage in the Cities: Refuse Reform and the Environment: 1880 – 1980*. Texas: Texas A&M Press.

Moulaert, F., F. Martinelli, E. Swyngedouw, and S. Gonzalez. 2005. Towards Alternative Model(s) of Local Innovation. *Urban Studies* 42 (11): 1969–1990.

National Bureau of Statistics. 2014. Rebasing of National Accounts Statistics: Methodology Notes on Gross Domestic Product (GDP) Rebasing Exercise. April

2014. Abuja: National Bureau of Statistics. nigerianstat.gov.ng/pages/download/198. Accessed 02 June 2014.

National Planning Commission. 2004. *Meeting Everyone's Needs: National Economic Empowerment and Development Strategy*. Abuja: NPC.

———. 2007. *National Economic Empowerment and Development Strategy-NEEDS2*. Abuja: NPC.

National Population Commission. 1991. *Nigeria Population Census 1991*. Abuja: NPC.

New Economics Foundation. 2012. *Measuring Wellbeing: A Guide for Practitioners*. London: New Economics Foundation (NEF).

New York Times. 1869. Our Rag pickers, How and Where they Live – the Fag End of the Dry Goods Business. November 21, 1869 Archives of the New York Times. Cited in Shrimati Nathibai Damodar Thackersey (SNDT) Womens' University and Chintan Environmental Research and Action Group (2010). *Recycling Livelihoods: Integration of the Informal Recycling Sector in Solid Waste Management in India*. Project Report, GTZ, Eschborn.

Nwafor, J.C. 2002. Manufacturing Industries. In *A Survey of the Igbo Nation*, ed. G.E.K. Ofomata, 525–542. Onitsha: Africana First Publishers.

Nwosu, B.U., T.C. Nzeadibe, and P.O. Mbah. 2016. Waste and Wellbeing: A Political Economy of Informal Waste Management and Public Policy in Urban West Africa. *Review of African Political Economy* 43 (149): 478–488. https://doi.org/10.1080/03056244.2015.1084914.

Nzeadibe, T.C. 2009. Solid Waste Reforms and Informal Recycling in Enugu Urban Area, Nigeria. *Habitat International* 33 (1): 93–99. https://doi.org/10.1016/j.habitatint.2008.05.006.

———. 2013. Informal Waste Management in Africa: Perspectives and Lessons from Nigerian Garbage Geographies. *Geography Compass* 7 (10): 729–744. https://doi.org/10.1111/gec3.12072.

———. 2015. *Moving Up the Hierarchy: Involving the Informal Sector to Increase Recycling Rates in Nigerian Cities*. In *Future Directions of Solid Waste Management in Africa*, ed. R. Mohee and T. Simelane, 70–87. Pretoria: Africa Institute of South Africa.

Nzeadibe, T.C., and C.K. Ajaero. 2011. Development Impact of Advocacy Initiatives in Solid Waste Management in Nigeria. *Environment, Development and Sustainability* 13 (1): 163–177.

Nzeadibe, T.C., and R.N.C. Anyadike. 2010. Solid Waste Governance Innovations: An Appraisal of Recent Developments in the Informal Sector Niche in Urban Nigeria. *Geography Compass* 4 (9): 1284–1296.

———. 2012. Social Participation in City Governance and Urban Livelihoods: Constraints to the Informal Recycling Economy in Aba, Nigeria. *City, Culture and Society* 3 (4): 313–325.

Nzeadibe, T.C., and P.O. Mbah. 2015. Beyond Urban Vulnerability: Interrogating the Social Sustainability of a Livelihood in the in the Informal Economy of Nigerian Cities. *Review of African Political Economy* 42 (144): 279–298.

Nzeadibe, T.C., R.N.C. Anyadike, and R.F. Njoku-Tony. 2012. A Mixed Methods Approach to Vulnerability and Quality of Life Assessment of Waste Picking in Urban Nigeria. *Applied Research in Quality of Life* 7 (4): 351–370.

O'Riordan, T. 2013. Sustainability for Wellbeing. *Environmental Innovation and Societal Transitions* 6: 96–115.

Okorafor, A.E. 1975. Population Distribution, 1963. In *Nigeria in Maps: Eastern States*, ed. G.E.K. Ofomata, 52–54. Benin City: Ethiope Publishers.

Okoye, T.O. 1975. The Modern Phase of Urbanization. In *Nigeria in Maps: Eastern State*, ed. G.E.K. Ofomata, 76–78. Benin City: Ethiope Publishers.

———. 2002. Urban Life and Urban Development in Igboland. In *A Survey of the Igbo Nation*, ed. G.E.K. Ofomata, 178–194. Onitsha: Africana First Publishers.

Perry, S.E. 1978. *San Francisco Scavengers: Dirty Work and the Pride of Ownership*. Berkeley: University of California Press.

Porter, M.E. 2015. Marginal Recycling: Place and Informal Recycling in St. John's, Newfoundland. *Local Environment* 20 (2): 149–164.

Rouse, J.R., and S.M. Ali. 2001. *Waste Pickers in Dhaka: Using the Sustainable Livelihoods Approach – Key Findings and Field Notes*. WEDC: Loughborough.

Samson, M. 2009. *Refusing to be Cast Aside: Waste Pickers Organizing around the World*. Cambridge, MA: Women in Informal Employment: Globalizing and Organizing (WIEGO).

———. 2010. *Reclaiming Reusable and Recyclable Materials in Africa: A Critical Review of English Language Literature*, WIEGO Working Paper (Urban Policies) No 16. Women in Informal Employment: Globalizing and Organizing (WIEGO), Cambridge, MA. http://wiego.org/sites/wiego.org/files/publications/files/Samson_WIEGO_WP16.pdf. Accessed 26 Oct 2012.

Sarkar, P. 2003. Solid Waste Management in Delhi – A Social Vulnerability Study. In *Proceedings of the Third International Conference on Environment and Health, Chennai, India*. ed. J. Martin, M.J. Bunch, V.M. Suresh and T.V. Kumaran, 451–464. Department of Geography, University of Madras and Faculty of Environmental Studies, York University. 15–17 December, 2003.

Schenck, Catherina J., Nik Theodore, Phillip F. Blaauw, Elizabeth C. Swart, and Jacoba M.M. Viljoen. 2017. The N2 Scrap Collectors: Assessing the Viability of Informal Recycling Using the Sustainable Livelihoods framework. *Community Development Journal*. https://doi.org/10.1093/cdj/bsx018.

Schütte, S. 2006. *Poor, Poorer, Poorest: Urban Livelihoods and Vulnerability in Mazar-i-Sharif*. Kabul: Case Study Series, Afghanistan Research and Evaluation Unit (AREU).

Strasser, S. 2000. *Waste and Want: A Social History of Trash*. New York: Owl Books/Henry Holt.

Uchegbu, S.N. 2009. Effective Planning and Management as Critical Factors in Urban Water Supply and Management in Umuahia and Aba, Abia State, Nigeria. *Physics and Chemistry of the Earth* 34: 23–27.

UN-HABITAT. 2002. *The Global Campaign on Urban Governance: Concept Paper*. Nairobi: UNCHS.

Velis, C.A., D.C. Wilson, and C.R. Cheeseman. 2009. 19th Century London Dustyards: A Case Study in Closed-loop Resource Efficiency. *Waste Management* 29: 1282–1290.

Watson, V. 2011. *Inclusive Urban Planning for the Working Poor: Planning Education Trends and Potential Shifts*, Urban Policies Research Report No. 11. Women in Informal Employment Globalising and Organising (WIEGO). http://www.inclusivecities.org/research/RR11_Watson.pdf. Accessed 26 Jan 2012.

Wilson, D.C. 2007. Development Drivers for Waste Management. *Waste Management and Research.* 25 (3): 198–207.

Wilson, D.C., C. Velis, and C. Cheeseman. 2006. Role of Informal Sector Recycling in Waste Management in Developing Countries. *Habitat International* 30 (4): 797–808.

17

Designing Personal Sustainability into Organizational Culture: The Case of Burning Man

Morgan C. Benton and Nicole M. Radziwill

Background

How an organization produces something is just as important as *what* is produced. Even if a product or service perfectly satisfies the needs of the market, if the value chain that generated it is inefficient, plagued by defects and uncertainty, or degrades *future* resource availability, the quality of that outcome is reduced. Consequently, sustainability is an attribute of overall quality and is directly related to protecting from *resource collapse* across social, economic, and political contexts (Ostrom 2009). In short, sustainability requires effectively managing energy and other resources so that the carrying capacity of a system (or part of a system) is not approached and its renewability is preserved.

Quality is defined by ISO 9001 as the "totality of characteristics of an entity that bear upon its ability to satisfy stated and implied needs." An entity can be many things: a product, a process, a person or organization, a project or program, or an event. An entity can also be an intelligent agent, an autonomous software program that performs goal-directed actions on behalf of another entity. Thus, sustainability must be examined on many levels. When the entity is a project, program, or event, sustainability must include the capacity to continue the benefits that entity provides beyond the lifetime of the entity itself (Scheirer 2005). Quality systems organize people, processes, policies, and their interactions to provide a basis for auditing operations and engaging in continuous improvement (Radziwill et al. 2008).

M. C. Benton (✉) • N. M. Radziwill
James Madison University, Harrisonburg, VA, USA

R. Brinkmann, S. J. Garren (eds.), *The Palgrave Handbook of Sustainability*,
https://doi.org/10.1007/978-3-319-71389-2_17

A quality system requires that the core values for an organization are articulated, modeled by leadership, and reinforced. If a project or organization wishes to achieve its broad sustainability goals, one approach is to make *personal sustainability* a core value. It has been defined (Benton et al. 2011, 5) as:

> A person's ability to live a lifestyle that includes creating harmony, interconnection, and relatively high levels of awareness in one's values, thoughts, and behaviors as well as maintaining an increasing control over one's physical, emotional, social, philosophical/spiritual, and intellectual life.

The awareness of interconnections and conduct of individual actions and how they contribute to sustainability at higher levels can also improve business performance while helping to achieve broader sustainability goals (Moran and Tame 2013). Personal sustainable changes, which can be initiated using tools like Personal Sustainability Plans (PSPs), encourage people to introduce behaviors into their daily lives and routines (e.g. ridesharing, using reusable cloth grocery bags instead of plastic) that also improve sustainability at the organizational level. PSPs raise awareness about organizational sustainability and reinforce desired behavior by promoting engagement among the organization's members. The most critical element of interventions such as PSPs is that they provide the opportunity for deep self-reflection about one's relationship to organizational and societal impacts (Moran and Tame 2013), and this practice can be strengthened using multi-source feedback (Benton et al. 2011).

Sustaining a change (or improvement) in an individual or in a system requires a control plan; at the very least, the performance of the system must be closely monitored. A "cultural compliance change" may also be required through training, instituting additional regulations or policies, or both, and in all cases, the system should be continuously monitored (Brandt 2016). Without a value system that supports the change, it is unlikely that the improvement will be sustained. Bertels et al. (2010) establish that "…a culture of sustainability is one in which organizational members hold shared assumptions and beliefs about the importance of balancing economic efficiency, social equity and environmental accountability" (p. 10). These assumptions and beliefs should be modeled by leaders and reinforced by protocols and practices.

Some organizations have approached sustainability as a business opportunity, recognizing that addressing externalities can yield significant bottom-line benefits (Joiner 2012). They have found that strategies to reduce externalities can also reduce costs to the organization. These include:

- Reducing energy consumption
- Reducing water use
- Reducing waste
- Finding alternatives to single-occupancy vehicles
- Reducing the use of "questionable chemicals"
- Encouraging more efficient land use

With the exception of the last item, which requires coordination between individuals and involvement of management structures and/or regulatory agencies, each of these strategies can be implemented at both the personal and organizational levels.

In addition to these elements, personal energy use also contributes to individual sustainable behavior. For example, Cox (2010) examines personal sustainability in the context of activism and recommends that to maintain energy during a stressful time, you should (1) focus your activities (doing only the things that provide the most meaning and satisfaction to you), (2) engage in effective personal planning and time management, and (3) attend to self-care. An individual cannot engage in sustainable behavior that broadly benefits organizations unless he or she has the energy to pay attention to them and actively engage in self-reflection.

Case Study

This case study considers personal sustainability in the context of the Burning Man event, held annually in the Black Rock Desert of northwestern Nevada. At the end of every August, 70,000 people converge on the dusty, alkali playa to create a temporary society with its own unique culture and rules of engagement (called the 10 Principles). First held at the summer solstice in 1986 as a small cathartic gathering of friends on Baker Beach in San Francisco, the event grew quickly in subsequent years, as friends invited other friends to the iconic "effigy burn" that ultimately gave Burning Man its name (Rohrmeier and Bassett 2015).

Although sometimes referred to as a "festival," Burning Man is instead an ephemeral, experimental city with diverse demographics and participants of all ages—there are no planned musical guests or events beyond the burning of the Man on the final Saturday of the event and the "temple burn" on Sunday. Instead, attendees create the events and experiences they wish to contribute to the community:

> [T]he culture and community that have emerged around Burning Man model the new forms of 'hyper-socialized' production that characterize co-creation of value across organizational boundaries" [such as makerspaces and crowdsourcing]. "[The 30-year history of these] events provide a microcosm for studying idea generation, team formation, emergent leadership, new product development, and the full product development cycle compressed into a short time span. (Radziwill and Benton 2013, 8)

The layout of the city is nearly consistent from year to year, with a pentagon defined on the playa, marked by series of concentric semicircular roads and spokes that have the Man as a focal point in the center, with the Temple not far behind it in the unfilled part of the circle (Fig. 17.1). The spokes are labeled with the hours on a clock to make navigation intuitive: the 3:00 keyhole is in the east, 6:00 is to the south, and 9:00 lies toward the west. "Sound camps" that function like dance clubs with 500–1200-person occupancy are placed at 2:00 and 10:00, medics are at 3:00 and 9:00, and camps that have lots of children or families are placed near 6:00 where it is relatively quieter (although there is no place in Black Rock City where electronic music can't be heard to some level). The largest and most interactive camps are placed along the Esplanade, the smallest of the concentric circles and closest street to the Man, and Center Camp (at 6:00 along the Esplanade) provides a nexus and meeting point for groups that is unique because it's the only place in the City that engages in commercial activity—coffee and ice can be purchased from the Burning Man Organization. The road structure, the Man, the Temple, and Center Camp are clearly visible from the air (Fig. 17.2).

The primary unit of organization is the "camp." Prior to any Burning Man event, attendees self-select into groups of 10–200 people ("camps") who plan for the event together (often on time scales up to a year or more), organize aspects of local infrastructure such as trash management and greywater management, and organize an event or a service to offer other attendees. The camps have names that often reflect the nature of the camp's activities like Comfort & Joy, Champagne Lounge, Astral Headwash (the hair-washing camp), Moon Cheese (Facebook founder Mark Zuckerberg's camp, that gives away grilled cheese sandwiches), More Carrot (the Farmer's Market that gives away fresh vegetables), and Dream Society/Infinite Love (the authors' camp, with a meditation dome displaying the art of Amanda Sage).

Although Black Rock City has held the record for world's largest "leave no trace" event for years, it is now also the world's largest intentional community (Rohrmeier and Starrs 2014). The Burning Man Organization that manages the event provides the infrastructure for entering and exiting Black Rock City,

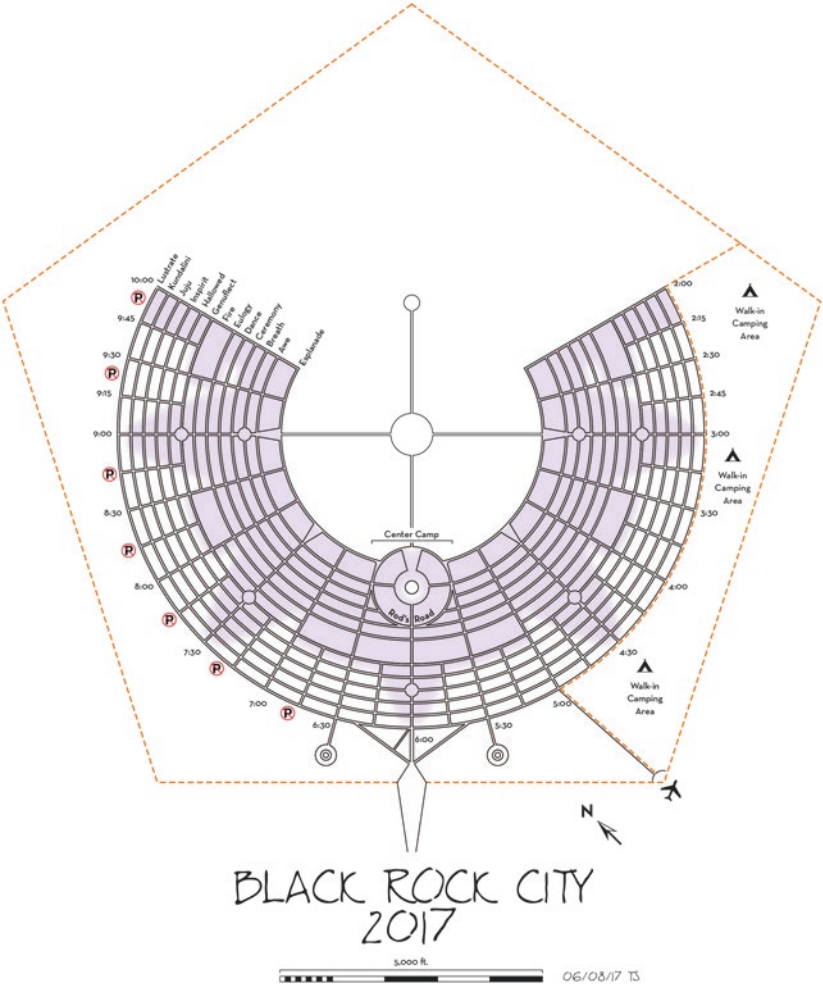


Fig. 17.1 City plan, Burning Man 2017 (Burning Man Organization, 2017. From https://burningman.org/event/black-rock-city-guide/2017-black-rock-city-plan/)

the definition of roadways and street signs, and thousands of port-a-potties, but citizens of the city provide everything else, from bars to dance clubs to educational activities to full-on conferences (Fig. 17.3). There are *no trash receptacles* anywhere within the city, except for maybe within camps, but those are not typically made available to the general public. This forces each person to think carefully about their own production of waste. In addition, no traditional vehicles are allowed within the City unless you are arriving, leaving, doing official duties for the Department of Public Works (DPW), or on an "art car" (vehicles that look like cupcakes, dragons, magic carpets, pirate ships, and more).

Fig. 17.2 Aerial view of Burning Man 2017 (Retrieved on September 4, 2017, from https://www.theatlantic.com/photo/2017/09/photos-from-burning-man-2017/538809/)

Fig. 17.3 The authors giving a talk about data science and the history of pseudoscience at Center Camp Speaker Series, Burning Man 2014

Participatory, immersive art plays a central role in Black Rock City, and in many cases, participants report that the art is the primary reason they attend because it catalyzes experiences that they describe as "transformative." About half of the participants report these transformative experiences, with nearly all of these claiming that the experience led to a positive shift in their personal value system (BRC Census 2016). Transformative experience is consistent with learning, and learning about yourself, others, or the environment around you. Participating in awe-inspiring art naturally lends itself to transformation

(Radziwill et al. 2015). Positive behavioral shifts (e.g. paying more attention to energy consumption, waste production, water use) can also be reinforced by associating the emotions of transformative experience to the experience of attending more consciously to personal sustainability.

Sustainability is a core value in the culture of Burning Man, which is encapsulated by the 10 Principles. These principles *describe* and *suggest* conduct within Black Rock City, but do not *prescribe* how it should manifest. The 10 Principles were articulated by one of Burning Man's founders, Larry Harvey, in an effort to explain the characteristics of the Burning Man culture that make it unique. They have been broadly accepted and informally adopted by the community. Presented in no specific order of significance or importance, they are (Harvey 2004):

- **Radical Inclusion**—There are no prerequisites for inclusion in the community. Everyone who participates is welcome and is to be included in the activities.
- **Gifting—**The community is built on the notion of gift-giving without expectation of receiving something in return (i.e. barter). Gifts can be items (e.g. artisan necklaces with the Burning Man symbol and the year, fuel for fire dancing, drinks) or services (e.g. hair washing, reiki, bike repair) and can be gifted by individuals or by whole camps.
- **Decommodification—**The culture of Black Rock City has the intention to "create social environments that are unmediated by commercial sponsorships, transactions, or advertising." The aversion toward marketing is so strong that it is common to see rental vans with the company logos covered by duct tape and poster board.
- **Radical Self-Reliance—**Each person should come to Black Rock City prepared to survive a week in the harsh desert, bringing food and water for themselves, and gifts to give to the community.
- **Radical Self-Expression—**Each person should "respect the rights and liberties" of others to a radical extent. This is the principle that gives rise to wild costumes, creative art displays, and unique, engaging experiences (e.g. a binaural audio show, a desert spa, or psychedelic participative art displays) that give Burning Man its reputation.
- **Communal Effort—**The community is built on creative and practical cooperation. Camps must be built and taken down, art installations must be created and destroyed, and community services (e.g. medics, airport) must be contributed. Nearly all of the elements of the community are contributed by participants.

- **Civic Responsibility—**Participants are responsible for promoting the general welfare of the community, including following laws and safety guidelines (despite the oft-heard phrase "Safety third!").
- **Leave No Trace—**Respect for the environment and leaving places in a better state than they were found are two key aspects of the community's core values. Since the event takes place on land held by the Bureau of Land Management (BLM), there can be no (even tiny pieces of) refuse left on the playa or the event would not be held.
- **Participation—"**No spectators" is also a guideline for the event. Everyone is invited to work, play, and make meaning through experiences and relationships.
- **Immediacy—**The Roman god Janus stood at the interface of the past and the future and thus exemplified the notion of immediacy—taking advantage of opportunities that present themselves in the moment, with an awareness of what led to this moment, and with an awareness of what this moment could lead toward. Because Janus was simultaneously looking forward and backward, he represented the point of power in the current moment. The principle of immediacy encourages everyone to derive experience, meaning, and purpose from this point of power (Radziwill 2013).

Even though the principles effectively summarize the key cultural elements of Burning Man, there are often spirited debates about how (and if) the principles are practiced. For example, what if one person's radical self-expression is so aberrant that it causes others to reject radical inclusion? How should radical self-reliance and civic responsibility be balanced (Caveat Magister 2013)? Should new principles, such as consent, be added (Lunas 2013)? Despite these philosophical issues, the 10 Principles have been strongly internalized by the Burner community. Sixty-five percent of the respondents to the 2016 Black Rock City Census report that they have integrated the 10 Principles into their work life, and eight percent of respondents have chosen to build their entire business culture around the 10 Principles (Fig. 17.4).

Lessons Learned

Many of the strategies outlined by Joiner (2012) are implemented at the personal level at Burning Man and reinforced by the 10 Principles as a value system. There are also specific behaviors that are common to Burning Man and affiliated events which could be adopted to enhance sustainability in other situations. These personal actions that contribute to sustainability at the level of the event include:

Fig. 17.4 Author Morgan Benton riding on top of an art car at Burning Man 2015

- **Reducing energy consumption**—Black Rock City is full of lights and art cars that have to be powered by something. Many strings of lights are battery powered, including the fairy lights that people decorate themselves with so that they don't get run over by bicycles or art cars on the dark streets at night. Unfortunately, the 2016 Black Rock City Census reported that 80 percent of the city is powered by gasoline, and this gasoline must be trucked in from Gerlach (11 miles away) or Fernley (91 miles away). Because it is nearly impossible to get more fuel during the week, individuals and camps must closely control how much generator power they are using and make sure that they don't run out. Unfortunately, this act of conservation does little to reduce energy consumption in any appreciable way. Large art installations, though, have historically turned to solar power as their primary source of power (Bee 2003); new installations are encouraged to do the same.
- **Reducing water use**—The requirement that each camp closely control its greywater production (and transport it offsite for disposal) provides a natural incentive to produce as little greywater as possible. Making this task particularly difficult is the requirement that no water at all be dumped on the playa, which can rapidly turn to a quicksand-like substance when wet, trapping vehicles. People instinctively change their behavior during activities like washing dishes to use as little clean water as possible, and to reuse or recycle water of varying degrees of cleanliness for different purposes (e.g. feet washing).
- **Reducing waste**—In Black Rock City, every person brings their own plastic or metal cup everywhere (usually attached to a belt or backpack with a carabiner). Bars will ask for your cup before they prepare your drink. As a result, there are very few disposable drink containers and they are never

offered. Proactive waste reduction begins, though, when you are preparing for the playa. Buying provisions with little or no packaging (e.g. bulk foods), and recycling and/or burning packaging before arrival, also serves to reduce waste. Choice of provisions is also important: it is best to avoid fruits and vegetables with rinds and peels that rot, unless your camp has a composting solution in place.

- **Finding alternatives to single-occupancy vehicles**—In addition to your Burning Man ticket, you also need to procure a vehicle pass for every car or RV on site. This means that individual sustainable behavior can be prescribed through policy: 7,000 fewer passes than usual were issued in 2016 to encourage ridesharing. Once on the playa, bikes are the most common form of transportation at the Burning Man, with art cars in second place. The Black Rock City Department of Mutant Vehicles (DMV) licenses each art car to ensure that a sustainable number of these types of vehicles are allowed on the playa each year.
- **Reducing the use of "questionable chemicals"**—Because water is such a precious resource on the playa, many camps pay more attention to the cleaning supplies they bring and use. For example, Dr. Bronner's environmentally friendly products are often seen in use. Many people bring vinegar to clean the alkali playa dust off of hands, feet, and limbs. Lemon juice and coconut oil are commonly used for multiple purposes.
- **Encouraging more efficient land use**—The Burning Man Organization restricts regular vehicle use (not art cars) to entry and exit only. Although not specifically "land use," it is a regulation that protects the environment to a small degree. In addition, the city layout is intentional and serves to segregate the camps in terms of noise and intensity levels, which serves to protect the ability of each individual to manage their own stress and energy levels.

Not mentioned by Joiner (2012), but still extremely important for achieving the integrated vision for personal sustainability outlined by Benton et al. (2011), is the ability to effectively manage one's own personal energy. This is particularly important on the harsh playa, where hunger, thirst, and heat exhaustion (coupled with the intense emotions associated with personal transformation) can wreak havoc on the body and psyche.

There are regular self-care reminders from the DPW, who ride around in cars, and proclaim (using megaphones and bullhorns) that if your urine is not clear, you should be drinking more water. If you are acting overwhelmed or irritable, even strangers will walk up to you and ask you to apply HALT (Hungry, Angry, Lonely, or Tired) to your current state, then will help you find the support you need to restore you to your emotional best. Campmates regularly encourage one

another to get enough sleep, to eat, and to stay out of the hot sun under a shade structure. Consequently, multi-source feedback (Benton et al. 2011) is built into the culture and conduct of the majority of Black Rock City's citizens. The strong degree of interpersonal care, consideration, and support helps individuals manage their own personal energy in a way that is unique to the Burning Man culture, but could be adopted by traditional organizations.

Challenges and Barriers

Sustainability as one of the core values of the Burning Man community does not, by itself, mean that the culture of sustainability has been perfected. Each year, tens of thousands of new attendees ("virgins") attend the event, bringing various degrees of awareness of—and commitment to—the 10 Principles. In addition, the degree to which seasoned Burners employ personal sustainability behaviors varies. There are many challenges that arise, but we will focus on five of them: MOOP, Sparkle Ponies, commodification camps, the event's carbon footprint, and its cultural sustainability.

- **Matter-Out-of-Place ("MOOP")**—Citizens of Black Rock City are hyperaware of their relationship to MOOP, no matter the size, because every camp is evaluated on how clean their piece of the playa is post-event. Within two to three weeks after each Burn, the (mostly volunteer) staff from the Black Rock City Department of Public Works (DPW) scours the landscape, camp by camp, to examine the playa surface for MOOP of all sizes. Every square centimeter of Black Rock City is examined to make sure nothing is left behind—not even a small amount of hair from a hairbrush or a single cigarette butt. The Burning Man Organization publishes a "MOOP Map" to show which camps met their civic responsibilities (green), which camps need improvement (yellow), and which camps significantly violated the principle of "leave no trace" by leaving bikes, vehicles, hexayurts, rebar, or partially or fully broken down buildings or structures (Fig. 17.5). A camp's MOOP status can influence whether it gets placement in subsequent years.

- **Sparkle Ponies**—Attendees who are "unprepared for the desert climate, putting excess strain on their campmates and who dress sexy or cute with fur and sparkles to playfully avoid work" (Ramey 2014, 208) are not usually received well by their campmates—or others on the playa who have to

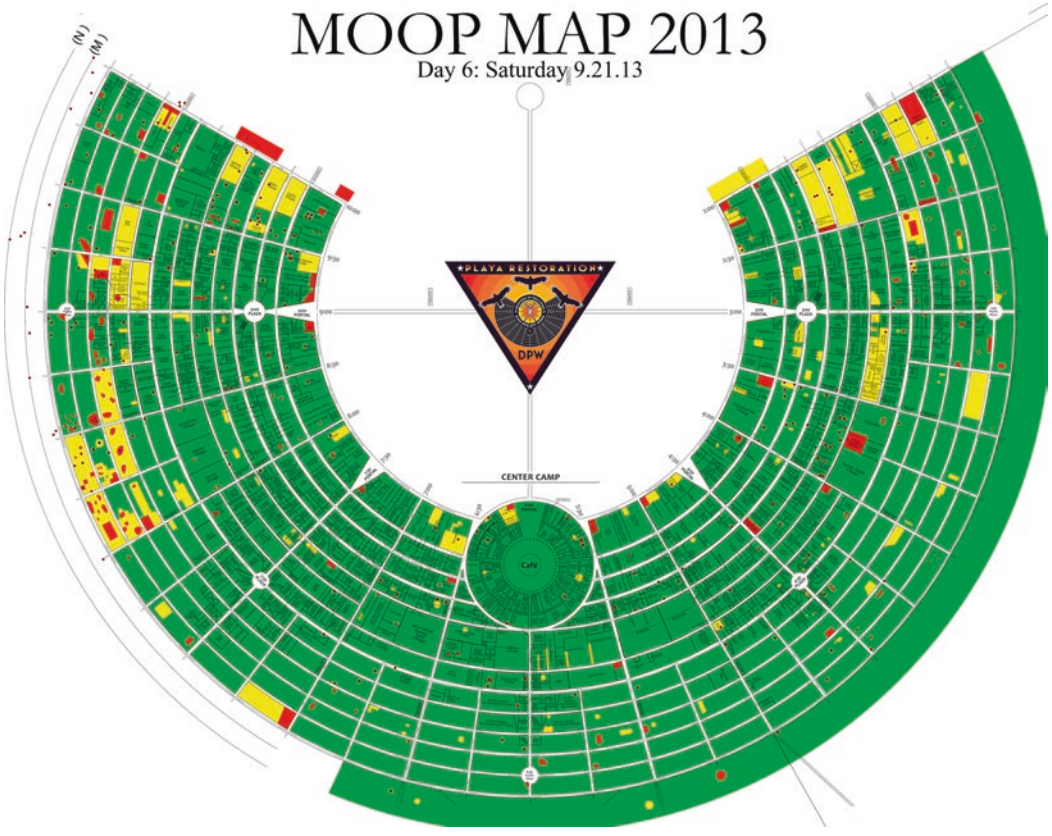


Fig. 17.5 Post-event matter-out-of-place ("MOOP") map for 2013 (From https://journal.burningman.org/2013/09/black-rock-city/leaving-no-trace/moop-map-live-day-6-the-outer-limits/)

provide food and water because they have brought none. Anecdotally, sparkle ponies do not seem to be as conscious about MOOP as other participants. For example, you will often see them wearing feathers or sequins (both prohibited on the playa due to their "MOOPiness").

- **Commodification Camps**—A new pattern that has emerged over the past five years is turn-key camps that charge exorbitant camp dues (upwards of $15,000) to set up sleeping space, provide provisions, and provide a service or activity that the participant can engage in to contribute to Black Rock City. There were two main problems with these camps. First, many other camps felt as if the turn-key camps were violating the spirit of the 10 Principles, namely, distancing the participant from radical self-reliance and decommodification—companies were now making money off of "providing the Burning Man experience" to rich customers. As explained by Rohrmeier and Bassett (2015), "field observations… reveal ideological rifts exist at camp scales, where spatial privatization is demonstrated through elite and isolating turnkey residential camping experiences" (p, 23). Second, the expensive turn-key camps were all marked red on the MOOP map during the second year they were recognized on the playa (2014). Many citizens of Black Rock City who were in "normal" camps were horrified that these turn-key camps would so flagrantly violate the "leave no trace" and "decommodification" principles, and after extensive (and sometimes highly emotional) online discourse, the Burning Man Organization responded (https://burningman.org/event/camps/turnkey-camping/).

- **Carbon Footprint**—Bloggers (e.g. Ayre 2015) have criticized Burning Man and its participants for aggressively promoting the philosophy of individual sustainability while holding an inherently unsustainable event. After all, more than half of the participants jet in from all over the world, many local and remote participants rent gas-guzzling RVs, and hundreds of people engage in demonstrations of fiery flow arts such as poi spinning which requires fuel to burn (Laing and Frost 2010). Eighty percent of the generators brought to the event in 2016 use gasoline, and less than two percent use biodiesel (BRC Census 2016). There is much improvement to be made.

- **Cultural Sustainability of the Event**—Although nearly 70,000 tickets are sold, the demand for Burning Man each year is at least four times that amount. Not everyone who wants to attend is able to attend at any given time. As a result, smaller regional gatherings have sprung up to meet the needs of Burners who want to experience the culture without

traveling such a long distance. But with no central cohesion, will the spirit and institutional knowledge of the community fade away? There are tens of regular, annual events, including Flipside in Austin, Texas, Frostburn in the Appalachians (held in the winter), Playa del Fuego in Maryland, Kiwiburn in New Zealand, Burning Japan near Tokyo, and Midburn in Israel. There is concern that the steady continued growth of the Burner population may serve to cut off the viability of the culture, as the main event becomes too difficult to access. As expressed by Rohrmeier and Bassett (2015, 44):

> As an organization somewhat hindered by its own ideals, Burning Man, under direction of its original visionary, recognizes this threat and pays significant consideration to annual planning endeavors, aiming to transition itself well beyond playa limits to several smaller, regionally sanctioned events, and to continued online social community growth. Whatever the future holds, Black Rock City remains a historically powerful contemporary cultural artifact and a reminder not to underestimate the unlikely few whose ideas have shaped the cities of many.

The most compelling outcome from our own participation in Burning Man events has been a profound level of awareness about our relationship with water, waste, and marketing messages. After living in the barren desert with 70,000 of your closest friends for a week, your relationship with each of these things begins to change. You begin to see how to messages you pass on highway billboards, during commercials on TV, and during commercials on YouTube influence your buying behavior. You begin to see non-recyclable packaging everywhere, and you start to make choices like not buying bottled water—but instead, filtering your tap water and bottling it yourself if you need drinking water outside the home. You start bringing cloth bags to the grocery store. You start feeling guilty every time you put compostable material in the trash and look for alternatives. Your family members who went to Burning Man with you start reminding you when you're engaging in a behavior that wouldn't be acceptable in Black Rock City.

All of these increases in awareness lead to small changes in behavior that ultimately yield benefits for the bottom line of your household, and an increase in the efficiency with which you use energy and resources. In addition, the reinforcement of these behaviors by being exposed (at least once a year) to a community that soulfully values sustainability and actively applies its 10 Principles on the playa and in the "Default World" is powerful and profound.

Further Reading

Black Rock City Census – Each year, the Census team (in which the authors participate at a small level) collects data about the demographics of Burning Man participants, their intentions, and their behavior on and off-playa. This 104-page document provides the best glimpse into the composition and culture of the event. https://drive.google.com/file/d/0BxJfvV_7__jqRTlpVHRWbGZIMkE/view

From Radical to Routine: Burning Man and the Transformation of a Countercultural Movement – This 85-page Master's Thesis examines the nature of Burning Man from the perspective of cultural sustainability, covering community, experience, and event. https://mdsoar.org/bitstream/handle/11603/2388/MACS_Fathalla_CapstoneFA2015_paper.pdf?sequence=1&isAllowed=y

Sustainability at Burning Man: The Next Chapter – In response to a petition posted on Change.org requesting that the Burning Man Organization accelerate its efforts to become more environmentally sustainable, an assessment was conducted. The summary of the document is at https://journal.burningman.org/2015/12/black-rock-city/leaving-no-trace/sustainability-at-burning-man-the-next-chapter/ and the Environmental Assessment is available from the Bureau of Land Management (BLM) at https://eplanning.blm.gov/epl-front-office/projects/nepa/28954/37412/39212/Burning_Man_DOI-BLM-NV-W030-2012-0007-Final_EA.pdf.

References

Ayre, J. 2015. Burning Man Has a Big Carbon Footprint (Unsurprisingly). *Clean Technica*, August 26. Accessed on October 1, 2017. https://cleantechnica.com/2015/08/26/burning-man-big-carbon-footprint-unsurprisingly/.

Bee, Lady. 2003. The Outsider Art of Burning Man. *Leonardo* 36 (5): 343–348.

Benton, Morgan C., Jesse Pappas, and Eric Pappas. 2011. WordPress+ Qualtrics: A Plugin Supporting Research and New Pedagogy to Develop Personal Sustainability via 360° Evaluation. In *AMCIS* 2011, p. 17th.

Bertels, Stephanie, Lisa Papania, and Daniel Papania. 2010. *"Embedding Sustainability in Organizational Culture." A Systematic Review of the Body of Knowledge*. London, Canada: Network for Business Sustainability.

Black Rock City Census of 2016. 2016. https://drive.google.com/file/d/0BxJfvV_7__jqRTlpVHRWbGZIMkE/view. Accessed 31 Aug 2017

Brandt, C. 2016. System Sustainability. *Quality Progress* 49 (6): 22.

Burning Man Organization. 2017. *2017 Black Rock City Plan*. https://burningman.org/event/black-rock-city-guide/2017-black-rock-city-plan/. Accessed 31 Aug 2017.

Caveat Magister. 2013. *Personal Communication*.

Cox, Laurence. 2010. How Do We Keep Going? Activist Burnout and Personal Sustainability in Social Movements. In *Fourteenth International Conference on Alternative Futures and Popular Protest*. Manchester Metropolitan University.

Harvey, L. 2004. The 10 Principles. *Burning Man Journal*. https://burningman.org/culture/philosophical-center/10-principles/. Accessed 31 Aug 2017.

Joiner, Brian L. 2012. Improvement in the New Millennium: Quality, Sustainability, and Externalities. *The Journal for Quality and Participation* 34 (4): 4.

Laing, Jennifer, and Warwick Frost. 2010. How Green Was My Festival: Exploring Challenges and Opportunities Associated with Staging Green Events. *International Journal of Hospitality Management* 29 (2): 261–267.

Lunas, M. 2013. *Transformus: The 11th Principle*. https://disruptingdinnerparties.com/2013/09/13/transformus-the-11th-principle/. Accessed 1 Sept 2017.

Moran, Brooke, and P. Tame. 2013. Employee Engagement: Advancing Organisational Sustainability. *Journal of Sustainability Education,* 5 (May). http://www.jsedimensions.org/wordpress/content/employee-engagement-advancing-organizationalsustainability_2013_06/.

Ostrom, E. 2009. A General Framework for Analyzing Sustainability of Social-Ecological Systems. *Science* 325 (5939): 419–422.

Radziwill, N. M. 2013. *Immediacy: A Janus-Faced Principle?* http://www.burningmindproject.org/2013/01/29/immediacy-a-janus-faced-principle/. Accessed 1 Sept 2017.

Radziwill, Nicole M., and Morgan C. Benton. 2013. Burning Man: Quality and Innovation in the Spirit of Deming. *The Journal for Quality and Participation* 36 (1): 7–11.

Radziwill, Nicole M., Diane Olson, Andrew Vollmar, Ted Lippert, Ted Mattis, Kevin Van Dewark, and John W. Sinn. 2008. Starting from Scratch. *Quality Progress* 41 (9): 40.

Radziwill, Nicole M., Morgan C. Benton, and Cassidy Moellers. 2015. From STEM to STEAM: Reframing What It Means to Learn. *The STEAM Journal* 2 (1): 3.

Ramey, Heather Lee. 2014. *Performing Black Rock City: Theatre of Affect and Burning Man*. San Diego: University of California.

Rohrmeier, Kerry, and Paul F. Starrs. 2014. The Paradoxical Black Rock City: All Cities Are Mad. *Geographical Review* 104 (2): 153–173.

Rohrmeier, Kerry, and Scott Bassett. 2015. Planning Burning Man: The Black Rock City Mirage. *The California Geographer*, 54 (2014-2015): 23–48.

Scheirer, Mary Ann. 2005. Is Sustainability Possible? A Review and Commentary on Empirical Studies of Program sustainability. *American Journal of Evaluation* 26 (3): 320–347.

18

Political Leadership and Sustainability in Africa: Margaret Kenyatta

Jo-Ansie van Wyk

Background

Africa's sustainability and human development depend on its natural resources.[1] The importance of Kenya's natural resources is illustrated by its economic value to Kenyans. With more than 70 percent of Kenya covered by various forms of fauna and flora, international tourism to the country contributes approximately 12 percent to the country's Gross Domestic Product (GDP) providing at least 300,000 direct employment opportunities.[2] In 2016, tourism to Kenya contributed Sh. 300 billion to the country's economy.[3]

The beginning of the twenty-first century saw an escalation of wildlife crimes in Africa. In 2016, the World Bank estimated the annual cost of wildlife crimes in developing countries at US$70 billion.[4] According to the International Union for Conservation of Nature (IUCN) and Natural Resources Red List of Threatened Species, East Africa (where Kenya is located) has the highest number of threatened species of birds, mammals, and fish.[5] Kenya is not unaffected by these developments which threaten the sustainability of the country's natural resources and the economic value derived from it. Since its independence, Kenya has been at the forefront of the environmental agenda on the continent with Kenyans Richard Leakey, founder of WildlifeDirect, and Nobel Laureate Wangari Maathai of the Green Belt

J.-A. van Wyk (✉)
Department of Political Sciences, University of South Africa, Pretoria, Gauteng, South Africa

R. Brinkmann, S. J. Garren (eds.), *The Palgrave Handbook of Sustainability*,
https://doi.org/10.1007/978-3-319-71389-2_18

Movement, amongst others, internationally recognized for their contribution. In addition to this, the headquarters of the United Nations Environmental Programme (UNEP) is located in Nairobi, the Kenyan capital. Kenya's environmental crises and efforts to resolve these are well documented.[6]

This, notwithstanding, the number of elephants poached in Kenya since 2011 (298) has significantly increased from 2012 (384) to 2014 (1000), with the country's elephant population decreasing from 160,000 (1975) to 35,000 (2015).[7] From 2009, almost 60 tons of ivory has transited through the country.[8] Proceeds of these crimes—at US$100,000/kg of ivory—often benefit Asia's rising middle class and fund some of Africa's most enduring conflicts and groups like Al-Shabaab, the Lord's Resistance Army, and the Janjaweed.[9]

Whereas the literature on sustainability and contemporary political leadership in Africa is relatively large, literature on the role of African First Ladies (i.e., the wife of the incumbent President or Prime Minister) as politically influential and close to political leaders is scant and suggests that First Ladies tend to focus on developmental issues such as maternal health, education, women's issues, and their ceremonial duties.[10] More pertinent to this handbook is the scant reference to the role of First Ladies in environmental sustainability and conservation in their respective countries. Therefore, to contribute to this under-researched area, the focus here is on Kenya's First Lady, Margaret Gakuo Kenyatta (b. 1963), wife of Kenya's fourth post-independent President, Uhuru Muigai Kenyatta, inaugurated on April 9, 2013. Unlike her counterparts in the continent and elsewhere, Margaret Kenyatta has been the first African First Lady to break with the traditional role of First Ladies to include environmental sustainability issues in her work and activities. Since 2013, Margaret Kenyatta has been involved in campaigns to prevent rhino and elephant poaching and illicit trade in wildlife products in Kenya. She is also the patron of the Hands Off Our Elephants campaign.[11]

Case Study: First Lady Margaret Kenyatta of Kenya

The case study presented here illustrated the role and influence of political leadership, in particular, the role of the First Lady, in enhancing sustainability. Margaret Kenyatta, Kenya's First Lady, and her environment-related work provides an instructive example of this. Therefore, this section explores the importance of leadership in and the associated strategies to enhance sustainability.

For the purpose of this contribution, this chapter focuses on three interlinked dimensions of sustainability, namely, a political dimension, a social

dimension, and an environmental dimension in terms of environmental sustainability and, in particular, the role of Kenyatta's leadership in environmental sustainability.

Social Dimensions of Sustainability

Three aspects are relevant here, namely, the role of women, local traditions and cosmology, and technology. Kenya has a population of 43 million with a Human Development Index (HDI) of 0.54 and a poverty rate of 45.5 percent.[12] With more than 50 percent of Kenya's population women, it remains a very vulnerable country in terms of sustainability.

Since becoming Kenya's First Lady, Kenyatta has repeatedly expressed her views on conservation and sustainability. As the First Lady, she represents the status and position of women in her country. Kenyatta has repeatedly recognized the role of women and traditional values and practices in Kenya's efforts to achieve sustainability.[13] Although Kenya scores relatively well on the African Union Commission's index on gender equality, women predominantly rely on the environment for their livelihoods and are thus more vulnerable to biodiversity loss.[14] This perhaps explains why women have been less involved in environmental crimes in Kenya.

Kenyatta's focus on elephants, for example, is not accidental and speaks to her sensitivity of the inter-linked dimensions of sustainability. The Masai, one of Kenya's large ethnic groups, venerate elephants as spiritual beings as part of their cosmology. The loss of the country's elephant population is thus not only a loss of biodiversity but also a spiritual and cosmological loss. In 2016, for example, Kenyatta launched a campaign, the East Africa Grass-Root Elephant Education Campaign Walk to protect elephants in Kenya.[15] Themed "Ivory belongs to elephants," the reported aim of the walk was to support an environmental activist, Jim Nyamu, the Executive Director of an NGO, the Elephant Neighbours Centre, to raise awareness about the value of elephants and rhinos, mitigate human-elephant conflicts, and promote anti-poaching activities.[16]

Besides taking cognizance of Kenyans' traditional social and spiritual lives, Kenyatta has also used modern instruments of social interaction to communicate. Kenyatta is featured in a film documentary, *First Lady's Ivory Awareness*, on elephant protection, and the wildlife-human nexus observing that elephants "are about our [Kenyans'] lives, the economy and national security."[17]

Environmental Dimensions of Sustainability

Kenyatta's leadership with respect to this dimension focuses on four aspects, namely, recognizing customary livelihoods, involving local communities in wildlife protection, recognizing the role of earlier strong environmental leaders such as Nobel Laureate and compatriot, Wangari Maathai, and a unique rhetoric. Kenyatta is a strong supporter of harmonizing human and animal needs and livelihoods and has engaged with local communities to achieve this. In 2016, for example, she outlined the role of local communities in wildlife protection as those most affected when conservation efforts fail, describing local communities as the "first lines of defense" in conservation, citing the Masai people and the Imbirikani women as examples.[18] In an effort to improve human-wildlife sustainability, Kenyatta launched the Global Wildlife Program in May 2016.[19] She has also called for a global ban on domestic trade in wildlife to counter illicit trade, called for the empowerment of local communities to directly benefit from wildlife resources, and to uphold and secure customary tenure rights over land, animals, and forests.[20]

Kenya recognizes the Green Belt Movement and Wangari Maathai through a Wangari Maathai Day and the Wangari Maathai House. In recognizing Maathai, for example, Kenyatta positioned herself as an heiress to Maathai's environmental struggle. Moreover, Kenyatta, like Maathai, focused on the Kenyan custom *harambee* (working together), which is also the Kenyan motto.[21]

Kenyatta's sustainability rhetoric includes references to Kenya's "unique wildlife heritage," and describing the unique meaning of and significance of elephants for Kenyans' "lives, the economy and national security."[22]

Political Dimensions of Sustainability

As a First Lady, Margaret Kenyatta enjoys considerable political access and influence due to her proximity to the President, his inner circle, and the decision-making process. These resources enable a First Lady to participate in public life in support of her husband and the ruling party. More pertinent to this chapter, is Margaret Kenyatta's use of these political resources to enhance Kenya's sustainability. For this, she employed various political strategies. Since assuming the role of Kenya's First Lady, Margaret Kenyatta has employed various leadership strategies to promote sustainability in Kenya.

These strategies focused on the domestic, regional, and international political arenas.

The first stategy is agenda setting within the confines of convention. Kenyatta expanded the conventional role of the First Lady to include environmental sustainability. She also cleverly converted the role of hostess of the First Lady to support the sustainability agenda. In June 2014, she held several luncheons such as a State House Luncheon on Wildlife Conservation on the sidelines of the UN Environment Assembly.[23]

A second strategy is consultative leadership and presidential support. Kenyatta is on record for calling for a collaborative, consultative, and community-based model to secure Kenya's sustainability.[24] In 2016, Kenyatta joined her husband, President Uhuru Kenyatta, at the burning of 15 tons of confiscated ivory.[25] Kenyatta renewed her calls for the protection of the country's biodiversity and its elephant and rhino population. In fact, the First Lady (unlike her predecessors) set the stockpile alight. In Kenya, the burning of confiscated ivory is an important signal to poachers to disrupt the illicit ivory market and has also been done during the tenure of Presidents Daniel Arap Moi (12 tons) and Mwai Kibaki (5 tons).[26]

The third strategy is patronage and public endorsements. Kenyatta often participates in joint appearances with Cabinet members at national campaigns. In June 2013, Kenyatta, when visiting an NGO, the David Sheldrick Wildlife Trust which cares for baby elephants orphaned due to poaching, was accompanied by Kenya's Cabinet Secretary and Minister for the Environment, Water, and Natural Resources, Judi Wakhungu.[27] Apart from patronage and public endorsements of environmental initiatives, Kenyatta also regularly recognized and launched the conservation initiatives of Kenyans and Kenyan institutions. She has, for example, launched the National Bank of Kenya's reforestation and its town greening program in the north of the country and has commended the Bank's planting of 2.5 million trees elsewhere in the country.[28]

Richard Leakey's role in wildlife conservation is well-known. In 2013, his organization, WildlifeDirect, launched a new campaign, Hands off Our Elephants, with Kenyatta as its patron. In 2014, during a luncheon hosted by Kenyatta at State House, the UN Development Programme announced their partnership with the Office of the First Lady to fund the Hands Off Our Elephants campaign by donating US$100,000.[29] Kenyatta's patronage has been "instrumental" in involving various government institutions such as the Ministry of the Environment, Water, and Natural Resources, Kenya Wildlife Services, Kenya Airways, the Nation Media Group, the Kenya Tourism Board, the Kenya Tourism Federation, and Kenya Vision 2030.[30] Kenyatta has also

endorsed WildlifeDirect's guidebook on the country's new wildlife legislation, the Wildlife Conservation and Management Act of 2013.[31]

The fourth strategy is environmental diplomacy. As the Kenyan First Lady, Kenyatta is also expected to perform diplomatic functions. She does not only accompany her husband on diplomatic missions, or receive state visits, but Kenyatta has also been outspoken on the regional dimensions of the degradation of environmental sustainability. Some of the symbolic diplomatic functions she performed included the opening of various UN and World Bank conferences.[32] She has, for example, presented the keynote addresses at international conservation conferences such as the Global Wildlife Program (GWP), a US$131 million grant program, conference of the World Bank in partnership with the Global Environmental Facility to focus on wildlife protection in 19 African and Asian states.[33]

Kenyatta is also on record for calling on the East African Community to cooperate on efforts to prevent elephant poaching.[34] She is also a strong advocate for the harmonization of regional wildlife conservation legislation to combat cross-border poaching and illicit trade in wildlife products.[35]

In August 2013, Chinese citizen Biemei Chen was found guilty of ivory smuggling and sentenced to three years in prison.[36] Kenyatta's film documentary, *First Lady's Ivory Awareness*, premiered at a conservation conference in China. Her message was clearly against Asian societies that use African products obtained illegally.[37]

Lessons Learned

Margaret Kenyatta's, as Kenya's First Lady, involvement and influence in enhancing sustainability in Kenya is instructive for the lessons learned from this case:

- Environmental degradation threatens the livelihoods of Africa's most vulnerable populations.
- Leadership and leaders matter in setting and promoting the sustainability agenda. This includes symbolic leaders such as the First Lady.
- Leaders need to focus on the social, political, and environmental dimensions of sustainability.
- In an African context, the social dimension is important to achieve sustainability. This entails recognizing the role of the First Lady as a non-traditional political actor, the role of women, local traditions such as *harambee* (working together), and cosmology.

- The First Lady's political strategies such as agenda setting within the confines of convention, consultative leadership and presidential support, patronage and public endorsements, and environmental diplomacy contribute to enhancing the environmental debate in Kenya.

Kenyatta broke the mold of the traditional African First Lady and focused on more than the conventional First Lady issues such as women's development, child mortality, and maternal health. Kenyatta's case illustrates the importance of leadership in achieving sustainability. The case also highlights that achieving national development goals cannot succeed when environmental sustainability is compromised.

Challenges and Barriers

Margaret Kenyatta's efforts have produced some results such as a new role for the First Lady as a publicly known environmental activist. Kenyatta's efforts have supported that of her husband's government and local communities' efforts. She has created greater awareness of the role of leadership, practical solutions, and the importance of local communities in achieving environmental sustainability.

However, Kenyatta and that of the Kenyan government's efforts face severe challenges. First, the illicit trade in wildlife and natural resources in Kenya continues and includes trade in, among others, ivory, rhino horn, sandalwood, bushmeat, timber, fish, sharks, hippo teeth, pelts, and medicinal and aromatic plants.[38] Second, there is a need for greater law enforcement. Kenya is regarded as having the most stringent anti-poaching legislation carrying life sentences or a penalty of Sh. 20 million (US$1,200,000).[39] Despite this, concerns have been expressed that government officials remain involved in wildlife crimes.[40] Chinese citizens have been found guilty of illicit trade and some instances of government officials' involvement have also been reported.

Kenyans and their neighboring countries should work toward greater peace and stability. Sustainability is one of the first victims of conflict and instability which often result in poor border management, law enforcement, displaced population, and a severe lack of livelihood.

Notes

1. United Nations Economic Commission for Africa), *African regional report on the Sustainable Development Goals. Summary* (Addis Ababa: ENECA, 2015); 15.
2. WildlifeDirect, *A guide to the Wildlife Act of Kenya (WCMA 2013)* (Nairobi: Government of Kenya, 2015); 6.

3. "What next after the burning of the ivory," *Kenya Insights*, May 3, 2016.
4. "First Lady launches program to tackle human-wildlife conflict," *Capital News*, May 18, 2016.
5. UNECA, *African regional report on the Sustainable Development Goals. Summary*, 10.
6. Keith Somerville, *Ivory. Power and poaching in Africa* (London: C. Hurst & Co. Ltd, 2016); 99–134.
7. "What next after the burning of the ivory," *Kenya Insights*, May 3, 2016.
8. TRAFFIC, *Conservation stakeholders hammer out priority actions to fight wildlife crime in Kenya*, 2015.
9. "Hands off our elephants," November 1, 2013; "Kenyans rally to save their wildlife," *Mail & Guardian*, October 18, 2013.
10. Jo-Ansie van Wyk, "First Ladies in African Politics: Tinker, Tailor, Trickster, Trophy or Trump card?" Paper presented at an international, interdisciplinary conference on *Accountable Leadership and Sustainability in Africa: Religion, Democracy and Civil Society* celebrating the 40th Anniversary of the University of South Africa's (Unisa) Research Institute for Theology and Religion, Unisa, Pretoria, South Africa, April 21–24, 2015.
11. "Kenya's First Lady takes the helm in the war on poachers," *The Guardian*, June 27, 2014.
12. UNEP, *About Kenya*, 2017.
13. Margaret Kenyatta, *Speech by her Excellency, First Lady Margaret Kenyatta, during the official opening of the International Conference on Engaging Local Communities in Wildlife Conservation in Kenya*, Nairobi, Kenya, May 18, 2016.
14. African Union Commission, *African Gender Scorecard*, 2015.
15. "First Lady Margaret launches campaign to eradicate poaching and save jumbos," *The Star*, June 6, 2016.
16. Ibid.
17. Save the Elephants, *First Lady: Elephants are about our lives, economy, security*, May 11, 2016.
18. Margaret Kenyatta, *Speech by her Excellency, First Lady Margaret Kenyatta, during the official opening of the International Conference on Engaging Local Communities in Wildlife Conservation in Kenya*.
19. "First Lady launches program to tackle human-wildlife conflict," *Capital News*, May 18, 2016.
20. WildlifeDirect, *Focus on illegal ivory trade in the USA*, October 1, 2016; "First Lady launches program to tackle human-wildlife conflict," *Capital News*, May 18, 2016.
21. Margaret Kenyatta, *Speech by the First Lady during Wangari Maathai Memorial Gala Dinner*, Nairobi National Museum, March 11, 2016.
22. Margaret Kenyatta, *Statement by the First Lady of Kenya, H.E. Margaret Kenyatta on protecting elephant ivory and rhino horns*, April 30, 2016; Save the

Elephants, *First Lady: Elephants are about our lives, economy, security*, May 11, 2016.
23. "Kenya's First Lady takes the helm in the war on poachers," *The Guardian*, June 27, 2014.
24. Margaret Kenyatta, *Speech by her Excellency, First Lady Margaret Kenyatta, during the official opening of the International Conference on Engaging Local Communities in Wildlife Conservation in Kenya*, Nairobi, Kenya, May 18, 2016.
25. "What next after the burning of the ivory," *Kenya Insights*, May 3, 2016.
26. Ibid.
27. WildlifeDirect, *First Lady Margaret Kenyatta spearheads national campaign to save elephants*, June 19, 2003.
28. "First Lady Margaret Kenyatta, Somali counterpart Qamar Omar Ali, plant trees to mark Environment Day," *Jamhuri Magazine*, June 5, 2013; Margaret Kenyatta, *Statement From the First Lady of Kenya, H.E. Margaret Kenyatta On Protecting Elephant Ivory and Rhino Horns*. Press release, April 30, 2016.
29. "Kenya's First Lady takes the helm in the war on poachers," *The Guardian*, June 27, 2014.
30. *Msafiri*, Hands off our elephants, November 1, 2013.
31. Margaret Kenyatta, "Message of the First Lady of the Republic of Kenya, in WildlifeDirect," *A guide to the Wildlife Act of Kenya (WCMA 2013)* (Nairobi: Government of Kenya); 4.
32. Margaret Kenyatta, *Speech by her Excellency, First Lady Margaret Kenyatta, during the official opening of the International Conference on Engaging Local Communities in Wildlife Conservation in Kenya*, Nairobi, Kenya, May 18, 2016.
33. World Bank, *Engaging communities in wildlife conservation*, June 12, 2016.
34. "First Lady Margaret launches campaign to eradicate poaching and save jumbos," *The Star*, June 6, 2016.
35. "Kenya's First Lady takes the helm in the war on poachers," *The Guardian*, June 27, 2014.
36. "Kenyans rally to save their wildlife," *Mail & Guardian,* October 18, 2013.
37. Save the Elephants, *First Lady: Elephants are about our lives, economy, security*, May 11, 2016.
38. TRAFFIC, *Kenya*, 2017; UNODC (United Nations Office on Drug and Crime), *World wildlife crime report. Trafficking in protected species*, 2016.
39. "What next after the burning of the ivory," *Kenya Insights*, May 3, 2016.
40. Ibid.

Further Reading

Carmody, Padraig. 2011. *The New Scramble for Africa*. Cambridge: Polity Press.
Maathai, Wangari. 2010. *Replenishing the Earth: Spiritual Values for Healing Ourselves and Our World*. New York: Doubleday.

Somerville, Keith. 2016. *Ivory. Power and Poaching in Africa*. London: C. Hurst & Co. Ltd.

Southall, Roger, and Henning Melber, eds. 2009. *The New Scramble for Africa? Imperialism, Investment and Development*. Scottsville: University of KwaZulu-Natal Press.

Swart, Gerrie., Jo-Ansie van Wyk, and Maryke Botha. 2014. *The Oxford Handbook of Political Leadership*. Ed. R.A.W. Rhodes and Paul 't Hart, 659–669. Oxford: Oxford University Press.

Maathai, Wangari. 2004. *The Green Belt Movement: Sharing the Approach and the Experience.* New York: Lantern Books.

UNECA (United Nations Economic Commission for Africa). 2015. *African Regional Report on the Sustainable Development Goals*. Addis Ababa: ENECA.

UNODC (United Nations Office on Drug and Crime). 2016. *World Wildlife Crime Report. Trafficking in Protected Species*. [pdf] New York: UNODC. Available at: https://www.unodc.org/documents/data-and-analysis/wildlife/World_Wildlife_Crime_Report_2016_final.pdf. Accessed 3 Apr 2017.

van Wyk, Jo-Ansie. 2017. First Ladies in Southern Africa: Trophies or Trailblazers. *Politikon* 44 (1): 157–172.

WildlifeDirect. *A Guide to the Wildlife Act of Kenya (WCMA 2013)*. [pdf] Available at: http://kwcakenya.com/resources/Wildlife_Act_Summary_WildlifeDirect.pdf. Accessed 29 Mar 2017.

World Bank. *Engaging Communities in Wildlife Conservation*, June 12, 2016. Available at: http://www.worldbank.org/en/news/feature/2016/07/12/engaging-communities-in-wildlife-conservation. Accessed 17 Mar 2017.

References

African Union Commission. 2015. African Gender Scorecard. http://www.africanunion.org. Accessed 30 March 2017.

Capital News. 2016. First Lady Launches Program to Tackle Human-Wildlife Conflict, May 18. http://www.capitalfm.co.ke/news/2016/05/first-lady-launches-program-tackle-human-wildlife-conflict/. Accessed 29 March 2017.

Jamhuri Magazine. 2013. First Lady Margaret Kenyatta, Somali Counterpart Qamar Omar Ali, Plant Trees to Mark Environment Day, June 5. http://jamhurimagazine.com/index.php/kenya/4143-first-lady- margaret-kenyatta-her-somalia-counterpart-qamar-omar-ali-plant-trees-to-mark-environment-day.html. Accessed 17 March 2017.

Kenya Insights. 2016. What Next After the Burning of the Ivory, May 3. http://kenyainsights.com/what-next-after-burning-of-the-ivory/. Accessed 17 March 2017.

Kenyatta, Margaret. 2016a. Speech by Her Excellency, First Lady Margaret Kenyatta, During the Official Opening of the International Conference on Engaging Local Communities in Wildlife Conservation in Kenya, Nairobi, Kenya, May 18.

https://www.scribd.com/document/313010289/SPEECH-BY-HER-EXCELLENCY-FIRST-LADY-MARGARET-KENYATTA-DURING-THE-OFFICIAL-OPENING-OF-THE-INTERNATIONAL-CONFERENCE-ON-ENGAGING-LOCAL-COMMUNITIES-IN-WI. Accessed 29 March 2017.

———. 2016b. Speech by the First Lady During Wangari Maathai Memorial Gala Dinner, Nairobi National Museum, March 11. http://www.president.go.ke/2016/03/12/speech-by-the-firsy-lady-during-wangari-maathai-memorial-gala-dinner-nairobi-national-museum-friday-march-11th-2016/. Accessed 5 June 2017.

———. 2016c. Statement From the First Lady of Kenya, H.E. Margaret Kenyatta On Protecting Elephant Ivory and Rhino Horns. Press Release, April 30. http://allafrica.com/stories/201605020862.html. Accessed 15 Mar 2017.

Mail & Guardian. 2013. Kenyans Rally to Save Their Wildlife, October 18. https://mg.co.za/article/2013-10-18-kenyans-rally-to-save-their-wildlife. Accessed 17 March 2017.

Msafiri. 2013. Hands off Our Elephants, November 1. http://www.msafirimag.com/featured-article/1968/. Accessed 29 March 2017.

Save the Elephants. 2016. First Lady: Elephants Are About Our Lives, Economy, Security, May 11. http://www.savetheelephants.org/about-elephants-2-3/elephant-news-post/?detail=first-lady-elephants-are-about-our-lives-economy-security-kenya. Accessed 3 Apr 2017.

Somerville, Keith. 2016. *Ivory. Power and Poaching in Africa*. London: C. Hurst & Co. Ltd.

The Guardian. 2014. Kenya's First Lady Takes the Helm in the War on Poachers, June 27. https://www.theguardian.com/environment/africa-wild/2014/jun/27/kenyas-first-lady-takes-the-helm-in-the-war-on-poachers. Accessed 29 March 2017.

The Star. 2016. First Lady Margaret Launches Campaign to Eradicate Poaching and Save Jumbos, June 6. http://www.the-star.co.ke/news/2016/06/06/first-lady-margaret-launches-campaign-to-eradicate-poaching-and-save_c1363592. Accessed 29 March 2017.

TRAFFIC. 2015. *Conservation Stakeholders Hammer out Priority Actions to Fight Wildlife Crime in Kenya*. http://www.traffic.org/home/2015/4/28/conservation-stakeholders-hammer-out-priority-actions-to-fig.html. Accessed 15 March 2017.

UNECA (United Nations Economic Commission for Africa). 2015. *African Regional Report on the Sustainable Development Goals. Summary*. Addis Ababa: ENECA, 15.

UNEP. 2017. About Kenya. http://www.ke.undp.org/content/kenya/en/home/countryinfo.html. Accessed 15 March 2017.

UNODC (United Nations Office on Drug and Crime). 2016. *World Wildlife Crime Report, 2016. Trafficking in Protected Species*. https://www.unodc.org/documents/data-and-analysis/wildlife/World_Wildlife_Crime_Report_2016_final.pdf. Accessed 3 April 2017.

van Wyk, Jo-Ansie. *First Ladies in African Politics: Tinker, Tailor, Trickster, Trophy or Trump Card?* Paper Presented at an International, Interdisciplinary Conference on

Accountable Leadership and Sustainability in Africa: Religion, Democracy and Civil Society Celebrating the 40th Anniversary of the University of South Africa's (Unisa) Research Institute for Theology and Religion, Unisa, Pretoria, South Africa, 21–24 April 2015. WildlifeDirect, Focus on Illegal Ivory Trade in the U.S.A. 1 October 2013. http://baraza.wildlifedirect.org/2013/10/01/focus-on-illegal-ivory-trade-in-the-u-s-a/. Accessed 29 March 2017.

WildlifeDirect. 2015. *A Guide to the Wildlife Act of Kenya (WCMA 2013)*, 6. http://kwcakenya.com/resources/Wildlife_Act_Summary_WildlifeDirect.pdf. Accessed 29 March 2017.

19

Environmental Law

Yumiko Nakanishi

Background

The concept of sustainable development in the field of Environmental Law has been a global topic since the report *Our Common Future* by Brundtland in 1987.[1] Fischer et al. opines that the concept of sustainable development is the most contested of environmental principles.[2] Bell et al. comment that the goal of sustainable development has been translated into some form of legal obligation in many legal documents although the legal effect of the obligation is the subject of significant debate.[3] Koch considers the concept to be one of international customary law based on the idea that it has been recognized in many international, regional, and national legal systems.[4] Birnie et al. explain that there remain fundamental uncertainties about the nature of sustainable development particularly whether sustainable development can be considered a legal principle.[5]

Case Study

The Concept of Sustainable Development

In Germany, the concept of sustainability originated from forestry laws and was historically used as a principle for forest economics.[6] The concept of sustainable development originated in the report *Our Common Future* by

Y. Nakanishi (✉)
Graduate School of Law, Hitotsubashi University, Kunitachi-shi, Tokyo, Japan

R. Brinkmann, S. J. Garren (eds.), *The Palgrave Handbook of Sustainability*,
https://doi.org/10.1007/978-3-319-71389-2_19

Brundtland in 1987.[7] According to the report, sustainable development is "development that meets the needs of the present generation without compromising the ability of future generations to meet their own needs."[8] The concept of sustainability includes three elements—economy, environment, and equity. Equity requires each generation to use and develop natural resources in such a manner that they can be passed on to future generations in no worse condition they were received.[9] Further, the concept of sustainable development integrates economic, environmental, and social issues, including human rights.[10] In other words, the concept of sustainability comprises economic growth, environmental protection, and social well-being.[11] The principle of sustainable development, as it is used in international documents, constitutes soft law in the context of international law.[12] It is also connected with environmental law and policy.[13]

Growth of the Concept of Sustainable Development

The UN Conference on the Human Environment was held in Stockholm, Sweden, on June 16, 1972. It was the first major conference on environmental protection. The Stockholm Declaration, which resulted from the conference, did not expressly refer to the concept of sustainable development but did include its components.[14]

The World Commission on the Environment and Development (WCED), whose chair was Gro Harlem Brundtland, was convened by the United Nations in 1983.[15] Brundtland's report, *Our Common Future*, introduced the concept of sustainable development for the first time in 1987.[16]

The United Nations Conference on the Environment and Development (UNCED), known as the Earth Summit, took place at Rio de Janeiro, Brazil, from June 3 to 14, 1992. The Rio Declaration and Agenda 21 are important outcomes of the UNCED. The Rio Declaration contains 27 principles which are related to sustainable development.[17] For example, according to Principle 1, "Human beings are at the centre of concerns for sustainable development. They are entitled to a healthy and productive life in harmony with nature."[18] Principle 3 says, "the right of development must be fulfilled so as to equitably meet developmental and environmental needs of present and future generations." Agenda 21[19] is a nonbinding and voluntarily implemented action plan[20] which is essentially an extended blueprint for encouraging the growth of sustainable development.[21] For example, the introduction in Chapter 2.1 of Agenda 21 says,

> in order to meet the challenges of environment and development, States decided to establish a new global partnership. This partnership commits all States to engage in a continuous and constructive dialogue, inspired by the need to achieve a more efficient and equitable world economy, keeping in view the increasing interdependence of the community of nations, and that sustainable development should become a priority item on the agenda of the international community.

In the year 2000, UN Millennium Development Goals (MDGs) were set. The stated objective of Goal 7 was to ensure environmental sustainability.

Ten years after the Rio Earth Summit, the World Summit on Sustainable Development (WSSD) was held in Johannesburg, South Africa from August 26 to September 04, 2002. The Johannesburg Declaration on sustainable development built upon the Rio Principles and Agenda 21, and emphasized the integration principle of sustainable development by stating, "we assume a collective responsibility to advance and strengthen the interdependent and mutually reinforcing pillars of sustainable development: economic development, social development and environmental development at the local, national, regional and global levels."[22]

The Delhi International Law Association (ILA) released a Declaration on Principles of International Law relating to sustainable development at its 70th Conference on April 2–6, 2002.[23] The declaration is composed of seven principles on sustainable development.[24] For example, Principle 3 is the principle of common but differentiated responsibilities: "States and other relevant actors have common but differentiated responsibilities. All States are under a duty to co-operate in the achievement of global sustainable development and in the protection of the environment."[25] Further, Principle 3 says that international organizations, corporations, non-governmental organizations and civil society should cooperate in and contribute to this global partnership. According to Principle 7, "the principle of integration reflects the interdependence of social, economic, financial, environmental, and human rights aspects of principles and rules of international law relating to sustainable development as well as of the interdependence of the needs of current and future generations of humankind."

Twenty years after the Rio Summit, the UN conference on sustainable development (UNCSD) (Rio+20) was held in Rio de Janeiro, Brazil on June 20–22, 2012. As an outcome of the conference, *The Future We Want* was published.[26] This document proclaims that "We therefore acknowledge the need to further mainstream sustainable development at all levels, integrating

economic, social, and environmental aspects and recognizing their interlinkages, so as to achieve sustainable development in all its dimensions."

On September 25, 2015, the UN sustainable development goals were adopted as a new sustainable development agenda which was to be achieved by 2030. There were 17 goals: 1, no poverty; 2, zero hunger; 3, good health and well-being; 4, quality education; 5, gender equality; 6, clean water and sanitation; 7, affordable and clean energy; 8, decent work and economic growth; 9, industry, innovation, and infrastructure; 10, reduced inequalities; 11, sustainable cities and communities; 12, responsible consumption and production; 13, climate action; 14, life below water; 15, life on land; 16, peace, justice, and strong institutions; and 17, partnerships for the goals.[27]

Sustainable Development and Environmental Law

The principle of sustainable development prevails now at international, regional, and national levels. In the field of international law, it is considered to be a type of soft law. The International Court of Justice (ICJ) began to recognize the principle of sustainable development and to use it in its decisions.[28] For example, the ICJ referred to sustainable development as a guiding principle in the Gabčíkovo-Nagymaros Project (Hungary/Slovakia) case in 1997, saying, "[t]his need to reconcile economic development with protection of the environment is aptly expressed in the concept of sustainable development."[29] Further, Vice President Weeramantry recognized the importance of the principle of sustainable development and expressed his views about it in a separate opinion concerning the case.[30]

The principle of sustainable development can also be found at the national level. For example, Article 20a of German Basic law (the German Constitution) states, "Mindful also of its responsibility toward future generations, the state shall protect the natural foundations of life and animals by legislation…."[31] These words represent the idea of sustainable development.[32] In Japan, the principle of sustainable development was inserted in a constitution for environmental law, Japanese Basic Environmental Law. Article 3 of the Basic Law states that environmental conservation shall be conducted to ensure that present and future generations of human beings can enjoy the benefits of a healthy and productive environment.[33]

The principle of sustainable development has an important role in European Union Law. It originally appeared in the report by Brundtland, *Our Common Future*, in 1987. After the report, the concept began to be discussed worldwide. For example, the Rio Summit, producing the Rio Declaration and

Agenda 21 toward sustainable development, was held in 1992. Responding to these developments, "sustainable growth" was inserted into the Treaty on European Union (Treaty of Maastricht) (TEU) in 1992. The EU has published environmental action programs since 1973. The fifth environmental action program was published on 1993. Its title was "Towards Sustainability."[34] The action program noted that the European Community (now the EU) would endeavor to find solutions in the field of development and environment in Rio de Janeiro in 1992, in order to contribute to promoting measures at international level to deal with regional or worldwide environmental problems.[35] The Treaty of Amsterdam, which was signed in 1997 and entered into force in 1999 and which amended the TEU, introduced the phrase "sustainable development." According to the Treaty of Amsterdam, the concept of sustainable development was referred to in the Preamble of the TEU, Article 2 TEU, Article 2 Treaty establishing the European Community (TEC), and Article 6 TEC. Article 2 TEU and Article 2 TEC were objectives of the EU and the European Community, respectively. In addition, Article 6 TEC laid down the principle of environmental integration. The Sixth Environmental Action Program, "Environment 2010: Our Future, Our Choice" was published by the European Commission. Therein, the EU defined the priorities and objectives of environmental policy and described the measures to be taken to help implement its sustainable development strategy. The Commission's proposal about sustainable development strategy was published in 2001.[36] The European Council adopted a renewed sustainable development strategy in 2006. A subsequent Communication from the Commission, "Mainstreaming Sustainable Development into EU Polices: 2009 Review of the European Union Strategy for Sustainable Development" was published on July 24, 2009.[37] The seventh environmental action program, "Living Well, Within the Limits of Our Planet," which reconfirmed the path toward sustainable development, was proposed by the Commission and adopted by the European Parliament and the Council on November 20, 2013.[38]

The Treaty of Lisbon entered into force on December 01, 2009. The TL amended the TEU and TEC substantially. The TEC became the Treaty on the functioning of the EU (TFEU). Consequently, the TEU referred to the concept of sustainable development in the Preamble, Article 3 (3) and (5) TEU, Article 21 TEU, and Article 11 TFEU. Articles 191, 192, and 193 TFEU composed the Title XX "Environment" section in the TFEU. The concept of sustainability was connected with the EU's environmental policy and those related articles to convey the principle of the best possible environmental protection (*Grundsatz des bestmöglichen Umweltschutz*).[39] Article 3 (3) TEU provided that "(the EU) shall work for the sustainable development of Europe based on balanced economic

growth and price stabilities, a higher competitive social market economy, aiming at full employment and social progress, and a high level of protection and improvement of the quality of the environment." The concept of sustainable development began to be used more broadly in European law. The Treaty of Lisbon, for example, addressed the external activities of the EU. Article 3 (5) TEU stated that the EU would contribute to the sustainable development of the Earth. Further, Article 21 (2) subparagraph (f) TEU says that the EU "shall define and pursue common policies and actions, and shall work for a high degree of cooperation in all fields of international relations, in order to …help develop international measures to preserve and improve the quality of the environment and sustainable management of global natural resources in order to ensure sustainable development." This policy is now restated in free-trade agreements and investment agreements involving the EU. Furthermore, Article 11 TFEU says, "environmental protection requirements must be integrated into the definition and implementation of the Union's policies and activities, in particular with a view to promoting sustainable development."[40] It is a horizontal clause, meaning the EU organs and the EU Member States are obliged to pay attention to environmental protection in not only the field of environmental policy but also in all policies and activities, by considering sustainable development. It is said that the principle of environmental integration has been instrumental in extending the legal roles of Article 191 (2) environmental principles (the precautionary principle, the preventive principle, the polluter pay principle, and the principle that environmental damage should as a priority be rectified at source) to other policy areas in the TEU and TFEU.[41] Furthermore, legislative acts (regulations, directives, and decisions), which are related to the environment, have been adopted not only in EU environmental policy but also in other policy areas. For example, one of the well-known laws of the EU, the REACH regulation regarding chemicals,[42] was adopted based on Article 95 TEC (now Article 114 TFEU), which is a legal basis for harmonization of the internal market.

Sustainable development has a high priority in the EU. The concept of sustainable development is one of the most important principles expressed in EU Law. However, the Court of Justice of the EU has not clarified the concept and has not assessed EU measures regarding their compatibility with the principle of sustainable development, even though Article 11 TFEU is legally binding and provides a legal obligation.

New Trends

The concept of sustainable development is generally considered to be soft law. It has been inserted into international documents such as the Rio declaration and Agenda 21. Now, a new trend is emerging. Current bilateral agreements

tend to expressly refer to sustainable development or even have a specific chapter for it.

The Trans-Pacific Partnership Agreement (TTP) is a mega free-trade agreement between Australia, Brunei, Canada, Chile, Japan, Malaysia, Mexico, New Zealand, Peru, Singapore, and Vietnam.[43] It was signed in Auckland, New Zealand, on February 4, 2016.[44] The TPP states in its Preamble that it will "promote high levels of environmental protection, including through effective enforcement of environmental laws, and further the aims of sustainable development, including through mutually supportive trade and environmental policies and practices."[45] Chapter 20 of the TPP is entitled "Environment." Article 20.2 of the TPP says, "the Parties recognize that enhanced cooperation to protect and conserve the environment and sustainably manage their natural resources brings benefits that can contribute to sustainable development, strengthen their governance and complement the objectives of this Agreement."[46] Further, Article 20.3 (General Commitments) requires that the Parties recognize the importance of environmental policies and practices to improve environmental protection in the furtherance of sustainable development. Article 20.12 (Cooperation Frameworks) provides that the Parties recognize the importance of cooperation to promote sustainable development as they strengthen their trade and investment relations. Article 20.13 (Trade and Biodiversity) requires that the Parties recognize the importance of conservation and sustainable use of biological diversity as well as their key role in achieving sustainable development. Chapter 23 is related to "development." Article 23.1 (General Provisions) says, "the Parties recognize the potential for joint development activities between the Parties to reinforce efforts to achieve sustainable development goals."[47] Article 23.3 (Broad-Based Economic Growth) states that the Parties may enhance broad-based economic growth through polices that take advantage of trade and investment opportunities in order to contribute to sustainable development and the reduction of poverty.

The EU has concluded and has been negotiating free-trade agreements with third countries containing the principle of sustainable development. There are also mega free-trade agreements containing the principle. For example, the EU and Canada signed the Comprehensive Economic and Trade Agreement (CETA) on October 30, 2017. The CETA refers to sustainable development in its Preamble, saying that the countries "[reaffirm] their commitment to promote sustainable development and the development of international trade in such a way to contribute to sustainable development in its economic, social, and environmental dimensions."[48] The CETA has a specific chapter for sustainable development, entitled "Trade and Sustainable Development" in Articles 22.1 through 22.5. Sustainable development is referred to also in chapters entitled "Trade and Labour" and "Trade and Environment." Article 22.1 (1) "Context and objectives" states:

> The Parties recognize that economic development, social development, and environmental protection are interdependent and mutually reinforcing components of sustainable development, and reaffirm their commitment to promoting the development of international trade in such a way as to contribute to the objective of sustainable development, for the welfare of present and future generations.

Canada singed both the TPP and the CETA. Both agreements refer to sustainable development. However, there are differences. The concept of sustainability in the TPP mainly aimed at environmental protection. On the other hand, sustainability in the CETA involves economic development, social development, and environmental protection—and, additionally, welfare of future generations. Thus, the principle of integration is also found in the CETA, coming from EU law and policy toward sustainable development.

Lessons Learned

- How is sustainable development defined?
- From where does the concept of sustainable development come?
- How has the concept of sustainable development developed?
- What is the legal character of sustainable development?
- How is sustainable development expressed in economic, social, and environmental issues?
- How is sustainable development expressed at international, regional, and national levels?
- What is the principle of environmental integration in EU law?
- How is sustainable development expressed in free-trade agreements?

Challenges and Barriers

The concept of sustainable development can be found at international, regional, and national levels, often in legal documents. The concept is discussed in not only environmental contexts but also in economic and social contexts, such as human rights. Thus, the concept is broad and comprehensive. It is used as a magic phrase with which all countries and people can agree in principle. The problem regarding the concept of sustainable development lies in its vague definition and expansive content. Berger-Walliser et al. comment that the phrase sustainable development is ubiquitous and is in danger

of being watered down or misused and losing its original meaning.[49] As a result, the principle of sustainable development should still be considered as soft law, which does not create a binding legal obligation.

Therefore, the implementation of provisions regarding sustainable development is problematic. Concretization of concept of sustainable development in national legislation and international obligations is more and more necessary in the future. The CETA between the EU and Canada might be an example of a potential solution. The CETA has a specific chapter for sustainable development and two other chapters which are related to it. Article 22.4 of the CETA sets forth institutional mechanisms for sustainable development. According to this Article, the Committee on Trade and Sustainable Development oversees the implementation of those related chapters.

Notes

1. The World Commission on Environment and Development, Our Common.
2. Fisher, Lange and Scotford, Environmental, 406.
3. Bell, McGillivray and Pedersen, Environmental, 60.
4. Koch, Umweltrecht, §1, para. 33.
5. Birnie, Boyle and Redgwell, International, 125.
6. Kloefer, Umweltrecht, §4, para. 31.
7. The World Commission on Environment and Development, Our Common.
8. The World Commission on Environment and Development, Our Common, 43.
9. Birnie, Boyle and Redgwell, International, 119.
10. Mekonin, Sustainable, 4–5.
11. Gupta, Sustainable, 15.
12. Fisher, Lange and Scotford, Environmental, 402.
13. Bell, McGillivray and Pedersen, Environmental, 57.
14. Gupta, Sustainable, 52.
15. Gupta, Sustainable, 56.
16. The World Commission on Environment and Development, Our Common, 43. Birnie, Boyle and Redgwell, International, 119.
17. United Nations Environment, 1992. Rio Declaration on Environment and Development. [Online] Available at: http://www.unep.org/documents.multilingual/default.asp?documentid=78&articleid=1163. [Accessed 16 February 2017].
18. Ibid.
19. United Nations Environment, 1992. Agenda 21. [Online] Available at: http://www.unep.org/documents.multilingual/default.asp?documentid=52. [Accessed 16 February 2017].

20. Gupta, Sustainable, 65.
21. Bell, McGillivray and Pedersen, Environmental, 60–61.
22. UN document, 4 September 2002, Johannesburg Declaration on Sustainable Development. A/conf.199/20. [Online] Available at: http://www.un-documents.net/jburgdec.htm. [Accessed 16 February 2017].
23. Gupta, Sustainable, 72–73.
24. See, also, Segger, The Role, 10.
25. ILA New Delhi Declaration of Principles of International Law Relating to Sustainable Development, 2 April 2002. [pdf] Available at: http://cisdl.org/tribunals/pdf/NewDelhiDeclaration.pdf. [Accessed 16 February 2017].
26. UN Document, 2012. Future We Want. [PDF] Available at: https://sustainabledevelopment.un.org/content/documents/733FutureWeWant.pdf. [Accessed 16 February 2017].
27. UN Sustainable Development Goals. [Online] Available at: http://www.un.org/sustainabledevelopment/sustainable-development-goals/. [Accessed 16 February 2017].
28. Bell, McGillivray and Pedersen, Environmental, 61; Segger, The Role, 14–15.
29. ICJ Reports, 1997, Judgment of 25 September 1997. Case concerning the Gabčíkovo-Nagymaros Project (Hungary/Slovakia), para. 140. [pdf] Available at: http://www.icj-cij.org/docket/files/92/7375.pdf. [Accessed 17 February 2017].
30. ICJ Reports, 1997, Case concerning the Gabčíkovo-Nagymaros Project, Separate Opinion. Separate Opinion of Vice-President Weeramantry. [pdf] Available at: http://www.icj-cij.org/docket/files/92/7383.pdf. [Accessed 17 February 2017].
31. Deutsher Bundestag, Basic Law for the Federal Republic of Germany. [PDF] Available at : https://www.bundestag.de/blob/284870/ce0d03414872b427e57fccb703634dcd/basic_law-data.pdf. [Accessed 16 February 2017].
32. Peter, Hesselbarth and Peters, Umweltrecht, para. 78.
33. Nakanishi, Introduction, 6.
34. Official Journal of the European Communities, 1993 C 138/5, 15 May 1993, A European Community program of policy and action in relation to the environment and sustainable development, [pdf] Available at: http://ec.europa.eu/environment/archives/action-programme/env-act5/pdf/5eap.pdf. [Accessed 19 February].
35. Ibid., C 138/11.
36. Communication from the Commission, A Sustainable Europe for a Better World: A European Union Strategy for Sustainable Development, COM(2001)264, [Online] Available at: http://eur-lex.europa.eu/legal-content/EN/TXT/HTML/?uri=URISERV:l28027&from=EN. [Accessed on 22 February 2017].
37. Communication from the Commission, COM(2009)400, [PDF] Available at: http://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:52009DC0400&qid=1487734795601&from=EN. [Accessed on 22 February 2017].

38. Official Journal of the European Union, 2013, L354/171, Decision No 1386/2013/EU. [PDF] Available at: http://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:32013D1386&from=EN. [Accessed on 22 February 2017].
39. Epiney, Umweltrecht, 5 Kapitel, para. 55.
40. As a critical reflection, Wagner, 191–200.
41. Fisher, Lange and Scotford, Environmental, 428.
42. Regulation 1907/2006 on the concerning the Registration, Evaluation, Authorization and Restriction of Chemicals, establishing a European Chemicals Agency, OJ 2006 L396/1.
43. The USA withdrew from the TPP on January 23, 2017.
44. TPP cannot enter into force because of the withdrawal of the USA.
45. Preamble of the Text of the TPP, [PDF] Available at: https://www.mfat.govt.nz/assets/_securedfiles/trans-pacific-partnership/text/0.-preamble.pdf. [Accessed on 22 February 2017].
46. Emphasis by the author. Chapter 20 of the text of the TPP, [PDF] Available at: https://www.mfat.govt.nz/assets/_securedfiles/trans-pacific-partnership/text/20.-environment-chapter.pdf. [Accessed on 22 February 2017].
47. Chapter 23 of the Text of the TPP, [PDF] Available at: https://www.mfat.govt.nz/assets/_securedfiles/trans-pacific-partnership/text/23.-development-chapter.pdf. [Accessed on 22 February 2017].
48. Text of the CETA, [PDF] Available at: http://data.consilium.europa.eu/doc/document/ST-10973-2016-INIT/en/pdf. [Accessed on 23 February].
49. Berger-Walliser and Shrivastava, Beyond, 422.

Further Reading

Boyle, A., and D. Freestone, eds. 1999. *International Law and Sustainable Development: Past Achievements and Future Challenges*. Oxford: Oxford University Press.

Gupta, K.H. 2016. *Sustainable Development Law*. India: Patridge.

Schrijver, N. 2008. *The Evolution of Sustainable Development in International Law: Inception, Meaning and Status*. Leiden: Martinus Nijhoff Publishers.

Schrijver, N., and Friedl Weiss, eds. 2004. *International Law and Sustainable Development: Principles and Practice*. Leiden: Martinus Nijhoff Publishers.

References

Bell, S., D. McGillivray, and O.W. Pedersen. 2013. *Environmental Law*. 8th ed. Oxford: Oxford University Press.

Berger-Walliser, G., and P. Shrivastava. 2015. Beyond Compliance: Sustainable Development, Business, and Proactive Law. *Georgetown Journal of International Law* 46: 417–474.

Birnie, P., A. Boyle, and C. Redgwell. 2009. *International Law & the Environment*. 3rd ed. Oxford: Oxford University Press.

Durán, G.M., and E. Morgera. 2012. *Environmental Integration in the EU's External Relations*. Oxford: Hart Publishing.

Fisher, E., B. Lange, and E. Scotford. 2013. *Environmental Law*. Oxford: Oxford University Press.

Gupta, K.H. *Sustainable Development Law*. India: Patridge. 2016.

Hebeler, T., E. Hofmann, A. Proelß, and P. Reiff, eds. 2017. *Protecting the Environment forFutureGenerations-Principles and Actors in International Environmental Law*, 191–213. Berlin: ErichSchmidt Verlag.

Kloepfer, M. 2004. *Umweltrecht*. 3rd ed. München: Verlag C.H.Beck.

Koch, H.-J. 2002. *Umweltrecht*. Neuwied: Luchterhand.

Krämer, L. 2015. *EU Environmental Law*. 8th ed. London: Sweet & Maxwell.

Mekonin, A.A. 2013. *Sustainable Development Law*. Saarbrücken: LAP LAMBERT AcademicPublishing.

Nakanishi, Y. 2016. Introduction: The Impact of the International and European Environmental Law on Japanese Basic Environmental Law. In *Contemporary Issues in Environmental Law*, ed. Y. Nakanishi, 1–13. Tokyo, Japan: Springer.

Segger, M.-C.C. 2009. The Role of International Forums in the Advancement of Sustainable Development. *10 Sustainable Development Law & Policy* 4: 4–18 and 78–80.

The World Commission on Environment and Development. 1987. *Our Common Future*. Oxford: Oxford University Press.

Wagner, E. 2017. The Principle of Sustainable Development—A Critical Reflection of European and Austrian Law. In *Protecting the Environment for Future Generations-Principles and Actors in International Environmental Law*, ed. T.H. Hebeler, A. Proelß, and P. Reiff, 191–213. Berlin: Erich Schmidt Verlag.

20

Brownfield Redevelopment: Recycling the Urban Environment

Elizabeth Strom

Background

Conservation, reuse, and recycling are concepts at the heart of decades of environmentalism. Brownfield redevelopment efforts apply these concepts to land use. Rather than "discard" land, often in cities, that may have been the site of polluting activities, these initiatives seek to remediate and repurpose these places, generating widespread benefits in the process.

Efforts to identify, remediate, and redevelop brownfields bring together those interested in environmental concerns and those engaged in urban development. These are two areas that ought to be connected, both in the academic world and among practitioners. Too often, however, they become siloed, with urban scholars and activists focused on the equitable redevelopment of disadvantaged neighborhoods and environmentalists focused concerns about urban pollution or on preservation of green areas outside the urban core. These groups can share an interest in addressing brownfields. For urbanists, the redevelopment of potentially contaminated city land is an important way to redevelop older urban areas and prevent the deterioration of the urban core. It's perhaps just a slight exaggeration to say that *all* urban development is likely to be brownfield development.

For environmentalists, brownfields cleanup most obviously directly rids the community of soil and water pollution. But, of equal significance, redevelopment in the urban core is the best possible alternative to sprawl, with infill

E. Strom (✉)
School of Public Affairs, University of South Florida, Tampa, FL, USA

R. Brinkmann, S. J. Garren (eds.), *The Palgrave Handbook of Sustainability*,
https://doi.org/10.1007/978-3-319-71389-2_20

construction on previously contaminated sites taking development pressure off of open space or agricultural lands at the urban fringe. Reusing previously developed land allows for denser development in cities, where compact communities can lead to greater walkability and use of transit while conserving natural areas outside the city.

What Are Brownfields and How Common Are They?

The federal Environmental Protection Agency (EPA) offers a rather legalistic definition of a brownfield as: "real property, the expansion, redevelopment, or reuse of which may be complicated by the presence or potential presence of a hazardous substance, pollutant, or contaminant." Stated more plainly, a brownfield is any property that is *or could be* contaminated. Among the common pollutants found on sites are fuels, solvents, heavy metals, asbestos, and PCBs (APA 2010). Any site that once housed a use that could have created pollution can get the designation of a brownfield.

Recent government estimates are that there are between 450,000 and a million brownfields in the USA. The uncertainty remains because often, until someone researches a site's history or tests its soil, its status as a brownfield is unknown. The designation of a site as a brownfield usually requires someone—quite often a local government—to seek that designation. As a result, there are probably thousands of yet unidentified sites across the country that could potentially earn that designation. Brownfields should not be confused with "superfund" sites, which have high levels of extremely hazardous contaminants, and are discussed further, briefly, below.

The term "brownfield" may conjure up images of industrial wastelands or trash-strewn lots, but in fact brownfields can be found anywhere. To be sure, the visibility and salience of brownfields may be highest in urban areas, especially in industrial regions. Manufacturing industries almost always will leave contaminants behind as part of a production process. In cities like Detroit or Baltimore, the decline of manufacturing, with plants moving to other regions starting even in the mid-twentieth century, has left behind large swaths of land no longer used for industry. If these cities are to remain viable, finding ways to redevelop these areas is key to survival.

But it is a mistake to think of brownfields as a concern unique to the so-called Rustbelt. All regions have some manner of manufacturing activity, which leaves behind similar cleanup problems. Moreover, heavy industry is certainly not the only sort of enterprise that can create site contamination. All former gas stations and auto repair shops are brownfields, as are dry cleaners

and lumberyards. Many former agriculture sites contain contamination, thanks to the use of fertilizers and pesticides. Even some golf courses, which have used fertilizers intensively, may require cleanup before redevelopment. When you realize that almost all potential redevelopment areas may fall into the brownfield category, it becomes clear that policies regarding brownfield redevelopment are likely to impact planning and building activities anywhere that has seen human activity.

Brownfields and Public Policy

The cleanup and reuse of brownfield sites is shaped by laws and practices at the federal, state and local levels of government, and has been an area of public policy involvement as far back as the 1970s. Perhaps the key piece of legislation in the evolution of brownfields programs is the Comprehensive Environmental Response, Compensation, and Liability Act, or CERCLA, passed in 1980. Responding to concerns that arose from industrial spills or negligent handling of some highly toxic substances, CERLCA was aimed at ensuring cleanup of some of the most hazardous sites in the country. Before CERCLA, too often, polluters could create environmental hazards and escape any responsibility for their impacts. CERCLA ensured that remediation and mitigation responsibilities were assigned to property owners, lenders, and other stakeholders; it also created the Superfund Trust Fund to support the cleanup of the worst of these sites where parties responsible for pollution could not be identified or were unable to pay.

While CERCLA was an important means to force polluters to clean up their messes, it had the effect of making potential buyers or developers reluctant to work with any sites that were known or suspected to be contaminated, lest they take on what could be costly responsibilities for environmental cleanup (Heberle and Wernstedt 2006). A series of measures, largely adopted through the Environmental Protection Agency (and often mirrored in state programs), created supports intended to offset some of those costs, and facilitate redevelopment of areas that contained contamination but not at the life-threatening levels of Superfund areas. Whereas the primary goal of Superfund site cleanup is to remove dangerous contaminants to reduce harm to human and natural environments (with redevelopment, if feasible, as a secondary benefit) brownfields policies are focused on getting land back into productive use.

To encourage the reuse of brownfield property, federal and state governments have created incentives and protections intended to offset the greater costs that such redevelopment may entail. There are federal laws as well as laws

in many states, for example, that limit the liability of property owners who were not themselves responsible for creating contamination found on a site; these laws are intended to overcome reluctance to purchase properties that could later be found to contain hazards. Since the 1990s, the federal EPA has offered a series of grants to local governments to carry out planning, assessment, and cleanup activities, as well as grants for training and technical assistance pertaining to brownfield remediation.

In addition, most state governments have their own brownfield assistance programs. It is at the state level that brownfields are defined, designated, and often documented—many states have databases of recognized brownfield sites (see here for Florida http://www.dep.state.fl.us/waste/categories/brownfields/pages/processes_county.htm or here for Indiana http://www.in.gov/ifa/brownfields/files/12-16-2016 percent20FINAL.pdf), and many states have programs that augment those offered at the federal level. States like Pennsylvania and West Virginia, where extractive and other environmentally damaging industries have left their mark, have particularly active brownfields programs, offering grants, loans, and technical assistance aimed at lowering the barriers to redevelopment and catalyzing economic revitalization. But robust state-level brownfields programs with a variety of redevelopment incentives can be found across the country. Massachusetts and Ohio, for example, are among several states offering low-interest loans to public or private sector developers to help pay for assessment and cleanup. Some, like Indiana, abate property taxes on businesses built on brownfield sites and others, like Florida, award bonuses for jobs created on such sites. Some states, including Florida, Massachusetts, and New York, also use tax credits as a means of encouraging brownfield reuse. Tax credit programs allow developers to deduct some of the costs of cleanup from their state tax liability. These tax credits can also be sold to others, making them useful even for those (nonprofits or governments) that don't have tax liability themselves. Tax credits were one of the funding mechanisms used in the case of Waterworks Park, described below.

In summary, public policies addressing contaminated land must deal with some contradictory imperatives (Ben Dor et al. 2011). On the one hand, it is the government's job to ensure public health and safety, and to that end regulatory policies are used to require remediation of pollution and, when appropriate, assignment of legal and financial responsibilities to polluters. On the other hand, such regulatory requirements can raise the complexity and cost of redeveloping areas that could be valuable community assets. Federal and state laws have therefore sought to set clear standards, punish those who fail to follow those standards, but also incentivize those who are willing to clean up brownfield sites and put them to productive use.

What Is the Process for Redeveloping a Brownfield Site?

Turning an unused, possibly contaminated site into usable space can be a complicated process, involving a host of actors who must be able to carry out property research, environmental assessment and cleanup, financial analysis, and urban design tasks. Generally, the scope of the cleanup is specified in agreements entered into between the developer and either state or local environmental agencies.

Actors

Brownfield redevelopment generally occurs when there is interest in building on a site where potential contamination must be assessed and addressed. The impetus for this redevelopment can come from a number of directions.

In some cases, redevelopment is a public sector effort, undertaken by a local government to create public uses. A city or township government may want to build a public facility, such as a school, or remove a neighborhood eyesore by turning a vacant lot into a park. Waterworks Park, the Tampa, Florida, case discussed below, was one in which a city government turned surplus property into a riverfront park.

But brownfield redevelopment is hardly an activity found exclusively or even primarily within the public sector. Real estate developers and other business owners are, in many cases, the initiators or key participants. Private sector actors, after all, take the lead in the majority of urban development projects, and they are likely to see the potential for business development that can come with the reuse of often centrally located sites. For example, a national development firm took the lead in transforming the shuttered Atlantic Steel mill, located in the heart of Atlanta. With the creation of a special taxing district generating revenues to help offset the cost of removing 180,000 cubic yards of lead-contaminated soil, the developer created Atlantic Station, a mixed-use, transit-oriented community that is home to several thousand households as well as a shopping district.

Nonprofit organizations and community-development organizations are another, sometimes unappreciated, sector that plays an important role in brownfield development. In some cases, community groups may provide support or input into redevelopment plans led by public or private sector participants. In other cases, however, community groups may themselves take key roles in brownfield redevelopment efforts. For example, the Champlain Housing Trust in Burlington, Vermont, a membership-based neighborhood

nonprofit, acquired a contaminated former bus depot, using public funds and a state program to limit liability in brownfield cleanups. The historic site now houses 20 apartments and needed commercial enterprises including a laundromat (APA 2010).

Whether a project is initiated by a local government, a private developer, or a nonprofit association, it will involve the work of a number of experts throughout the process. There are firms that specialize in carrying out environmental assessments, others that can undertake site remediation. Urban planning and design professionals will be engaged in planning for the property's reuse, and architects will be involved in building design. Financial analysts might be involved to help calculate project costs and deal with the complexities of applying for and managing public grants or tax credits. While cities, development firms, and nonprofits may have some of these experts working in-house, in most cases these are experts brought in to the project via contract.

Processes: Assessment and Cleanup

There is no single path to the redevelopment of a brownfield site. Generally, when a previously built-on site has been identified for redevelopment, research (known as a Phase I Environmental Site Assessment) can begin to determine whether the site is likely to contain dangerous pollutants. This research usually includes a search of property records, a visit to the site, and if possible interviews with previous owners or neighbors. Knowing how the site has been used in the past will help determine whether there is a good chance it is contaminated. If Phase I research gives any hint that the site might need remediation, a Phase 2 study will be conducted, during which soil and groundwater will be tested. The results of these tests will reveal levels of contamination and suggest the sorts of cleanup that could be carried out before further development is undertaken.

What level of mitigation is required before development can move forward? There is no one answer to that question. First, there may be some differences in requirements depending on the state where the site is located. Many cleanup standards are spelled out in federal law, and applied through Environmental Protection Agency (EPA) regulations, and are therefore similar across the country. But states can also promulgate their own environmental regulations, so in some cases brownfield mitigation must conform to higher, state-based standards. Second, different sorts of contaminants require different kinds of cleanup. Some contaminants may be deemed containable, and a

developer can simply cap off the area by applying a concrete slab over the soil. In other cases, contaminated soil must be removed, with the amount of soil depending on the nature of the contaminant and the degree of contamination found through testing. In some cases, bioremediation—introducing microbes, perhaps through soil amendments that can break down contaminants—can help rid sites of pollution. There are even plants known to pull contaminants from soil; "phytoremediation" can help further cleanup goals while also creating more attractive landscapes (Price 2012). Cleanup plans will therefore vary from site to site.

Moreover, remediation plans are also very much shaped by reuse. Different sorts of reuses require different levels of cleanup, with reuses likely to produce long-term exposure by humans and especially children (residential areas, schools) requiring far more extensive mitigation than uses with limited human exposure. If a landowner plans to use a site for a parking garage, for example, the level of cleanup may be far different than if a site is meant to be developed for housing.

Those seeking to develop brownfields therefore face a complex cost-benefit analysis. The costs and difficulties of cleanup or mitigation need to be calculated, taking into account both the type and degree of contamination, and the standards deemed safe for the intended new use of the land. It may, for example, prove too technologically difficult and financially onerous to redevelop some highly contaminated sites to a level where they could be used for housing. In some larger sites, the level and nature of contamination may vary across a site, so a developer could put homes on the least-compromised parcels and use the other areas for parking or utilities. The complexity of the decision-making process has led to the creation of brownfield redevelopment cost-benefit calculation tools (http://wvbrownfields.org/tools-2/).

To summarize, the identification of brownfield sites usually requires some initiative on the part of public, private, or nonprofit actors who have an interest in redeveloping the area. These actors will then work to navigate a process that involves environmental, planning, design, and financial calculation.

Case Study: Waterworks Park, Tampa, Florida

Tampa Heights, located just north of the city's downtown, was developed in the 1890s as Tampa's first suburb, a neighborhood of cobblestone streets and stately Victorian-era homes for the city's growing professional class. As was common at that time, the area closest to the Hillsborough River, which meanders through the city, was given to commercial uses and infrastructure; in this

case there were buildings housing a trolley barn for the streetcar system and a pump house that extracted water from the adjacent Magbee Spring, named for the one-time owner of the property (a local judge who had been known for his drunkenness and forced to resign from the bench in 1875). Some other industrial operations took advantage of the commercially active waterfront.

Fast forward a century, and Tampa Heights had fallen upon some of the same woes as many other inner-city neighborhoods. Upper- and middle-class families had moved to outlying suburbs, with automobiles and an interstate highway system making proximity to downtown less important. Riverfront industrial uses had become obsolete; with trains, trucks and planes available for transport fewer industries needed to be near water, and those that did moved to larger port facilities. Tampa abandoned its streetcar system and hence had no need to house these vehicles; the Magbee Spring was no longer a source of city water and was left to become smothered by overgrowth. While Tampa Heights still had charming tree-lined streets, many of its homes had deteriorated, and its declining population was on average poorer than most parts of the region. The neighborhood's riverfront area was not attractive or easily accessible to residents, with older industrial structures either empty or only partially used. The city had declared part of the area to be a public park (Waterworks Park) but few knew of this designation given the dearth of park amenities and lack of area maintenance.

Thanks to an active resident association that pushed continually for thoughtful planning and revitalization, and city leadership interested more broadly in creating a lively urban waterfront, beginning in the 1990s came efforts to improve the neighborhood, and in particular to turn the long-neglected public land along the river into a community and regional asset through cleanup and redevelopment activities. The city's Public Works Department's decision to close a fleet maintenance facility along the river, which had included three underground, 10,000-gallon fuel tanks, further expanded the land available for reuse. Several redevelopment plans were heralded by successive mayors and trumpeted by private developers; the plan to get the most traction was proposed in the mid-2000s, and would have redeveloped 48 acres into 1900 condominium units, a hotel, and a commercial center along with a marina. As part of the land purchase agreement with the city, the developer had agreed to clean and develop a linear park along the waterfront, which would link to the Riverwalk under development through the downtown area, just to the south. Their project, however, fell victim to the recession, which left the area in limbo.

Fortunately, however, the city stepped in to keep a Waterworks Park renewal alive. Across two mayoral administrations, city officials had been applying

federal grant funds and local resources to the Riverwalk, and even without the developer's help decided to extend that work north, to the Tampa Heights area. The city decided to undertake the assessment, cleanup, and restoration/renovation of 5.9 acres of Tampa Heights riverfront parcels. Coordinating efforts of the city's Parks and Recreation and Public Works Departments, plans were laid to clean up this land and turn the park into an amenity that would connect to the newly opened downtown Riverwalk.

After testing soil and water on the site and identifying contaminants, a plan was developed to remediate the site to a residential quality, largely by removing and replacing two feet of soil everywhere except where doing so would destroy trees, or where contaminated soil was to be covered with a concrete cap. Part of the land was set aside for a playground, and the park would also include a riverside trail, a dog park, a band shell, and an event lawn which has hosted a variety of events since opening in 2014 (Fig. 20.1).

The shoreline of the river was restored and lined with mangroves and other native species. The long-neglected spring received new life in several ways. First, a high school student had researched the spring's history, and after learning of Judge Magbee's checkered past suggested renaming the spring after Ulele, the daughter of a Timucuan tribal chief who helped Spanish explorers investigating the area in the 1500s; both the spring and the nearby restaurant now bear her name (Houck 2014). More importantly, the spring was cleaned and restored, the spring bed excavated, expanded and lined with sand, with attractive native landscaping surrounding it. In addition to public sector effort and funding, a host of neighborhood associations and civic groups have been active in cleanup efforts, and the results are impressive, with

Fig. 20.1 Waterworks Park, Band Shell in Background

a wide variety of aquatic life now visible from the banks of the river and the spring.

As part of this redevelopment effort, the city decided to see whether the old waterworks building, deemed historically significant, could become a site for a restaurant. They issued a request for proposals, and ended up contracting with the Gonzmart family, who have been prominent restauranteurs and civic activists in Tampa for over a century. The Gonzmarts would be able to lease the property for just $1 a year, but they were responsible for renovating the old structure (Houck 2014). The original estimates suggested that renovations would cost about $2 million and take a bit over a year; given the challenges of the site, however, construction required an additional 2 years and in the end cost $5 million (Fig. 20.2).

Most of the park renovation funds came from the county's Capital Investment Tax, but project managers were also able to leverage support for remediation through the Florida Brownfields Voluntary Cleanup Tax Credit program. This program provides credits against corporate taxes to businesses that clean up and reuse designated brownfields; those without tax liabilities can sell these credits to businesses that can use them. Tampa was deemed eligible for just under $460,000 in tax credits, and the city was able to sell those to a bank that had tax liability in the state for $0.91 on the dollar, earning just over $400,000 toward remediation and renovation costs. In addition, some of the expenses associated with spring and shoreline restorations have been provided by public and nonprofit environmental groups such as the Florida Freshwater Fish and Wildlife Commission and the Tampa Bay Estuary program.

Fig. 20.2 Ulele restaurant with Ulele spring in foreground

Lessons Learned

As the successful redevelopment of Tampa's Waterworks Park shows, brownfield redevelopment is the very definition of win-win, meeting the goals of environmentalists while also providing opportunities for market-driven activities. Many urban investment and service programs have been subject to cutbacks and elimination over the years in more conservative political climates. Brownfields programs, however, can gain support across political and ideological spectrums (Greenberg 2003). They are appealing to private developers and pro-growth leaders who want to create new investment opportunities, and to neighborhood advocates who seek to bring needed financial and physical capital to underserved neighborhoods while address environmental justice concerns.

Public programs that help offset costs, limit liability, and provide needed technical assistance can set the stage for broader redevelopment activities that benefit a wide range of community and business interests. At a time when so many areas of public policy, and so many aspects of sustainability, have become grist for political polarization, brownfield efforts would appear to be a topic that can draw support across sectors and ideologies.

We can see this "win-win" quality in the case of Waterworks Park. Here, a natural area, including spring and river shoreline, has been restored and soil contaminants removed, creating a healthier environment for area residents. In so doing, city officials have also created an aesthetic and recreational amenity, as visitors enjoy strolling along the water, and can now launch boats from the restored shoreline.

But brownfield redevelopment seldom stops at simply removing hazards. The goal of these efforts is to recycle "pre-used" properties and make them functional again. The cleaned-up area now serves as a multi-use park that meets the needs of a number of constituencies, from families with children who can enjoy the playground to dog owners, joggers, cyclists, and anyone who appreciates a green respite for the downtown.

In addition, by partnering with Ulele restaurant, the city leveraged a $5 million private investment toward the renovation of a historic building. The restaurant has become a beloved amenity for people across the region, employing 160, contracting with local producers, and generating significant sales tax in a location that just a few years ago was merely a hazard. Whatever the end of use of cleaned-up brownfield, it is likely to generate a positive economic impact, employing people at a variety of skill levels in assessment, remediation, construction, and a variety of end uses.

Waterworks Park is also instructive because, like many brownfields, it is located in an urban area, and located at a strategic spot whose revitalization can have a ripple effect well beyond that one site. The public investment in Waterworks Park has provided a stimulus for other, long-stalled redevelopment plans to renovate the Trolley Barn building, which will become an upscale food court, and the development of other vacant riverfront sites into apartments and shops. Reclaiming important urban infill sites shifts regional development from the urban fringe to the urban core, making it politically easier and economically more feasible to preserve open spaces and resist sprawl.

Challenges and Barriers

Although brownfield remediation and redevelopment has multiple benefits, there are still many challenges that may stand in the way, as well as unintended consequences that can prove problematic even for successful projects.

Firstly, not all brownfield redevelopment efforts are guaranteed to succeed along any measure. For a project to get past the discussion stage, many factors must align. All complicated development projects (and brownfield sites are by definition complicated) need champions who can marshal the various skills and financial resources needed to push the project forward. Even with strong leadership, there are some sites that may not be good candidates for redevelopment. Some sites may be poorly located, and there are certainly cases where cleanup costs are too extensive to make remediation feasible, or where there are insufficient financial resources to support intended redevelopment purposes.

Secondly, designating a site or an area a "brownfield" can generate community opposition. This may be especially true outside of the urban core, where residents may be less inclined to see their communities as locations in need of remediation. There are many instances in which property owners and realtors discourage public leaders from seeking brownfields designations or applying for brownfields grants, even though in so doing they may be forgoing some significant investment supports. They fear that the "brownfields" label will create negative associations for a community and perhaps hurt property values. For example, Davis (2011) describes community opposition to a brownfields initiative in rural Zephyrhills, FL, where an opponent adorned his truck with a sign reading "Stop Brownfield Project if you value your land. Land Value will Drop."

Thirdly, most brownfields programs are set up to encourage cleanup and redevelopment; few tie those benefits to the end use of any new development. That has led some critics to question their value. Eisen (2007) notes that projects accomplished with the help of brownfields initiatives may include some that are badly designed, or have generated community opposition. Others contend that brownfield redevelopment contributes—whether unwittingly or by design—to gentrification. By making it easier to redevelop inner-city sites, brownfields programs can contribute to property value increases that can lead to rent and housing cost inflation with the effect of pricing out lower income, often long-term, residents. For example, Essoka (2010) found that brownfield redevelopment projects have been associated with declining African-American and Latino populations in surrounding areas, although other studies have not found a clear statistical relationship (Fisher 2011). This could be a concern in an area like Tampa Heights, where an influx of upper middle-class residents to the riverfront area made accessible through Waterworks Park could, in the long run, push up property values and price out longer-term residents. Current brownfields initiatives have no requirements that end users provide community amenities or protect the interests of nearby residents. It's not clear, however, that failing to remediate brownfield sites truly protects these residents against displacement. Critiques of brownfield development do raise appropriate concerns about redevelopment and equity, but those concerns really speak to the inherent problems of market-based redevelopment rather than brownfields programs themselves. Local authorities would be remiss if they were to fail to address contaminated areas in fear that remediation would make areas attractive and therefore more expensive.

In conclusion, sustainable urban development requires that regions "recycle" urban land rather than continually expand into rural areas at the fringe. By remediating pollution and facilitating redevelopment, brownfields policies have helped improve public health and environmental quality and at the same time encouraged more compact infill development.

Further Reading

American Planning Association. 2010. *Reuse: Creating Community Based Brownfield Redevelopment Strategies*. www.planning.org/research/brownfields.

Ben Dor, T., S.S. Metcalf, and M. Paich. 2011. The Dynamics of Brownfield Redevelopment. *Sustainability* 3 (6): 914–936. https://doi.org/10.3390/su3060914.

Davis, L. 2011. Critics Attack Brownfield Idea. *Tampa Bay Times,* October 25. http://www.tampabay.com/news/localgovernment/critics-attack-brownfield-idea/1198574.

Eisen, J.B. 2007. Brownfields at 20: A Critical Reevaluation. *Fordham Urban Law Journal* 34(721). Available at SSRN: https://ssrn.com/abstract=1921389.

Essoka, J.D. 2010. The Gentrifying Effects of Brownfields Redevelopment. *Western Journal of Black Studies* 34 (3): 299–315.

Fisher, B.H. 2011. *Brownfields Redevelopment and Gentrification: A Socio-Economic Evaluation of the EPA Brownfields Pilot Program*. Graduate Theses and Dissertations, Iowa State University, Paper 12021. http://lib.dr.iastate.edu/cgi/viewcontent.cgi?article=3040&context=etd.

Greenberg, M.R. 2003. Reversing Urban Decay: Brownfield Redevelopment and Environmental Health. *Environmental Health Perspectives* 111 (2): A74–A75.

Heberle, L., and K. Wernstedt. 2006. Understanding Brownfields Regeneration in the US. *Local Environment* 11 (5): 479–497.

Houck, J. 2014. Ulele, a Restaurant for the Next Century. *Tampa Tribune*, August 10. http://www.tbo.com/dining/ulele-a-restaurant-for-the-next-century-20140810/.

Price. 2012. Sunflowers for Lead. Spider Plants for Arsenic. *Metro Jacksonville,* July 8. http://www.metrojacksonville.com/article/2010-jun-sunflowers-for-lead-spider-plants-for-arsenic.

Websites

EPA. https://www.epa.gov/brownfields.

National League of Cities Sustainable Cities Institute. http://www.sustainablecities-institute.org/topics/land-use-and-planning/urban-infill-and-brownfields-redevelopment.

West Virginia Brownfields Assistance Center. http://wvbrownfields.org/.

Western Pennsylvania Brownfields Center. https://www.cmu.edu/steinbrenner/brownfields/.

21

Methodology for Selection of Sustainability Criteria: A Case of Social Housing in Peru

Daniel R. Rondinel-Oviedo
and Christopher Schreier-Barreto

Background

In the twenty-first century, the sustainability of any human activity must be evaluated, including access to housing, which is one of the basic rights of people. Housing design and construction must be efficient and sustainable over time.

Currently, housing is at a deficit globally. According to Inter-American Development Bank (IDB) numbers in Latin America and the Caribbean, such deficits reach up to 78 percent of families that do not have quality housing. In the case of Peru, it is estimated that the deficit reaches 72 percent of families (Banco Interamericano de Desarrollo 2012). In the case of Peru according to the National Institute of Statistics and Informatics (INEI) calculations (2015), the deficit is approximately 1.8 million units. Additionally, the Metropolitan Urban Development Plan (PLAM 2035) estimates that there are still 7.6 million people living in slums, which additionally lack facilities and public spaces. Solving this problem poses a massive construction effort that could seriously affect the environment due to the construction industry's considerable impact. We must ask ourselves, what are the sustainability criteria that should be considered when designing social housing in developing countries?

The quest for sustainability is relatively new to the Western society, which is rather accustomed to unlimited growth and to the use and abuse of natural resources. Achieving sustainability is a quest for the twenty-first century society,

D. R. Rondinel-Oviedo (✉) • C. Schreier-Barreto
Instituto de Investigación Científica, IDIC, Universidad de Lima, Lima, Lima, Peru

R. Brinkmann, S. J. Garren (eds.), *The Palgrave Handbook of Sustainability*,
https://doi.org/10.1007/978-3-319-71389-2_21

which in turn has the difficult mission of being a restorative society that corrects the mismanagement sustained during decades of the previous century.

The term "sustainable development" was officially proposed in 1987 in the report *Our Common Future* by the World Commission on Environment and Development (World Commission on Environment and Development 1987), known as the Brundtland Commission.

Sustainable development represents a balance between the human needs and the health and productivity of ecosystems. This definition is the basis for further ideas and definitions, for example, from a scientific perspective, "sustainability is a process of improving the quality of human life, without compromising the capacity and ecosystems that are its vital support" (Saura i Craulla 2003). A definition linked to the reality of developing countries defines that economic growth, more prosperity, and equal opportunities must be available for all and that the use of natural resources is for the benefit of present and future generations (Ozolins 2014).

For other authors, the concept of sustainable development "is born out of a capitalist society with the sole objective of continuing to create wealth in the same habitual way, but with another appearance" (De-Garrido 2011). This position—which at first may seem negative—has given rise to new explorations about the concept. Based on Sierpinski triangle, the fractal tile (Braungart and McDonough 2002a) subsequently evolved to fractal triangle (Braungart and McDonough 2002b).

In recent years, the problem of sustainability has been considered in the formation of new generations of architects. In this sense, the American Institute of Architects (2013) defines sustainability and sustainable design as a key element for the performance of twenty-first century architects. Further, the architect is an important entity in ensuring the sustainability of the city in Peru (Colegio de Arquitectos del Perú 2012).

Sustainability is the search for the balance between environmental, economic, and social factors based on the understanding of the place where a project is to be carried out. Strategies that may work for one reality or region may not be completely replicable elsewhere. For example, energy savings in developed countries respond to the need to reduce greenhouse gases; in a developing country, however, energy savings should be more closely associated with ensuring energy access to the entire population.

In developing countries, basic services such as electricity, water, drainage, safety, or health are not continuously provided or may not be provided at all. This reality is characteristic of societies that are in a rapid transition from a traditional to a globalized culture (Ozolins 2014). In addition, in marginal

urban areas, architecture must maintain an ecological balance, meeting the needs of the community (Miguel 2010).

Certifications and sustainability criteria are conceived in more developed countries. Then, how can sustainability be applied in developing countries? The first thing to consider when applying sustainability in developing nations is the limited economic resources, moreover, issues of security and availability of water and energy as well as lack of employment should be considered. This issue, in more developed countries, can be taken for granted. These problems can be resolved according to the following sustainability criteria: social-cultural, environmental, and economic (Ozolins 2014).

The Triple Bottom Line and the Fractal Triangle

The concept of the triple bottom line is linked to the definition of sustainable development given by the Brundtland Commission, which states that economic and social aspects must be linked to the bearing capacity of the environment. Since then, all activities that seek sustainability must analyze these three aspects (World Commission on Environment and Development 1987).

This concern became important only in the late 1970s. Then, in the 1980s, there was a dichotomy between development and the environment, and 1990s onwards, the idea became "economic development and management environmental aspects are complementary aspects of the same agenda" (Cárdenas Jirón 1999).

The concept of the triple bottom line defines that the interests of corporations should not only be based on economic value but also on social and environmental values. It is a useful tool used to balance the economic objectives of the companies with the concern for the environment. However, the application of the concept in practice tends to produce strategies that prioritize the economic perspective. To avoid this from happening, fractal triangles consider multiple interactions that can occur between the aspects that converge in each part of the triangle (Fig. 21.1) (Braungart and McDonough 2002a, b).

Sustainability in Architecture

Sustainable building addresses some objective aspects that are simple to analyze and quantify, such as energy or water use; it also addresses broader and difficult-to-quantify objectives such as conservation of building materials,

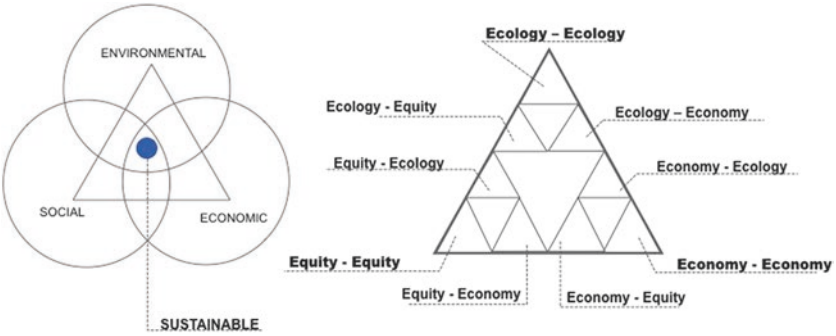


Fig. 21.1 Graphic adaptation of the triple bottom line concepts and fractal triangle (Braungart and McDonough 2002a, b) (Source: Own elaboration)

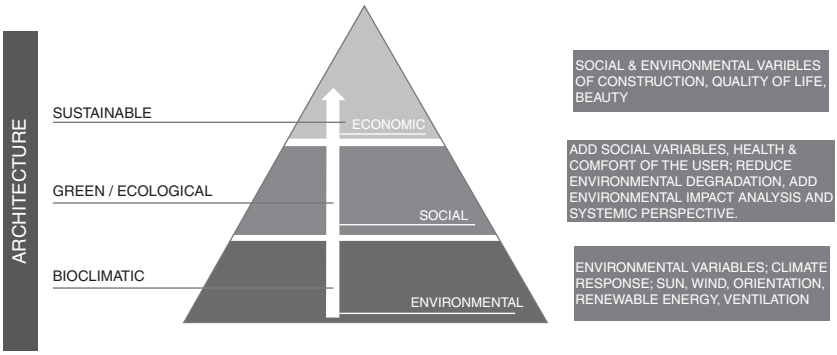


Fig. 21.2 Variables of sustainable, green and bio-climatic buildings (Source: Own elaboration)

indoor air quality, and comfort of the users. However, there are also subjective aspects such as the beauty of the building, its relation to the landscape, and social and even political aspects (Fig. 21.2).

The various definitions used may produce confusion between terms that are not synonyms and therefore lead to misuse of such terms. There are differences between a bio-climatic building, a green or ecological building, and a sustainable building. If a country is trying to promote sustainability in buildings, the concepts must be clear and the building designated as sustainable must meet expectations for a building of this category.

A bio-climatic building responds to the climate, addressing mainly environmental issues (such as orientation, natural ventilation, renewable energy, and thermal insulation), generating comfort and efficiency in energy consumption, without necessarily taking action on the impact generated by the building.

A green or ecological building understands the building as part of a system and studies the relationship between biotic and abiotic factors, considering the impacts of the building. This type of building seeks to minimize environmental pollution, improve the conditions of comfort and health of the inhabitants, protect habitats and water, and mitigate global warming among others, all from its design.

A sustainable building also considers a holistic vision and analyzes more elaborate social criteria, such as the quality of life of the community, equality, or beauty, considering the economic criteria that must guarantee profitability and not make the building more expensive. Likewise, it is linked to the satisfaction of needs of each specific reality, adapting its criteria according to the priority of each place. Producing this type of architecture also indirectly generates positive impacts on other realities.

We can say that a bio-climatic building is not always green, and similarly, a bio-climatic or green building is not always sustainable. However, a sustainable building must be bio-climatic and green, since sustainability is a broader term that balances out environmental, social, and economic aspects. These types of architecture styles require individual and political will to be realized.

To develop sustainable architecture, identifying design strategies is required. These strategies "must be easily identifiable and should have a very general character" (De Garrido 2009), allowing these to be applied to different realities and projects.

Sustainable Social Housing in Less-Developed Countries

In recent decades, the concern of social housing in Latin America has changed its focus. In the first place, the concern was the deficit, then the quality, and finally the integration of the inhabitants to their production processes (Pérez Pérez 2013). However, sustainability is not yet a problem that is consciously occupied by social housing (Ozolins 2014).

One of the main premises of sustainable housing in developing countries is to tackle poverty, the reduction of which can still be considered as an unfinished task. Adaptability and flexibility in the different architectural programs compels us to think of housing as a long-term growth scheme.

That is, understanding the social, economic, and environmental context are basic aspects before starting the design of sustainable social housing in countries like Peru. From a social perspective, it should improve the quality of life, ensure the health and safety of the users, accessibility to the project, and consider the aesthetic values. From the economic perspective, it should improve

the performance and durability of housing materials, save energy and water, reduce the cost of maintenance and price of housing; all of the latter are important points since a social housing cannot be sustainable with steep construction prices. Finally, from the environment aspect, sustainable housing must protect natural resources by promoting the efficient use of renewable resources. Avoiding contamination of water, soil, and air (Roufechaei et al. 2014) is also necessary.

There are some alternatives to sustainable housing, such as "bio-climatic dwellings" that mainly consider bio-climatic strategies, although an initial disadvantage is usually the over-cost of housing, recovering the investment with a life cycle of approximately 50 years (Zander 2009). In contrast, the "biocompatible housing" ensures energy efficiency; reduces noise and electromagnetic pollution; and uses natural materials, sunlight, and vegetation (Paredes Benitez 2014). Finally, the "energy-efficient housing" organizes the design into three aspects: architectural (passive energy saving, orientation, and envelope), mechanical (water heating), and electric (balance between natural and artificial light) (Roufechaei et al. 2014).

The development of sustainable social housing in Latin America has been studied by the United Nations Environment Programme that issued a document analyzing the situation in the region. This publication studies the case of nine countries including Argentina, Brazil, Colombia, Chile, Mexico, and Peru. The construction sector in Latin America represents between 2 percent and 15 percent of the gross domestic profit in each country. The selection of cases is based on the fact that "the housing deficit is a present condition in all countries. Therefore, housing supply is one of the national priorities to be addressed" (Programa de las Naciones Unidas Para el Medio Ambiente 2014).

The key sustainable construction initiatives for the case of Latin America are as follows: the development of national strategies for sustainable construction and the creation of laws that favor them, granting of subsidies and/or incentives to incorporate elements of sustainable construction in social housing developments, piloting projects of sustainable social housing, developing technical standards of sustainable construction, promoting green roofs through laws or programs, and developing Environmental Impact Assessment studies of state construction projects among others (Fig. 21.3).

In Peru, some of these initiatives have been developed in the last ten years, such as the granting of subsidies through the "MiVivienda Sostenible" bonus (Fondo MiVivienda 2014), developing pilot projects for sustainable social housing, promoting the use of green roofs, and assessing the environmental impact of state buildings (Programa de las Naciones Unidas Para el Medio

Argentina	Ensure comfort within homes according to the climatic zone
	Ensure Energy Efficiency
Brazil	Developing voluntary certification standards for sustainable construction appropriate to the local context and applicable to the social housing sector.
	Supplying housing demand through financial incentives to private companies.
	Tackling the housing deficit problem as an opportunity for economic growth.
	Subsidizing improvement of the environmental performance of low-income housing.
Colombia	Promoting rational and efficient use of energy.
	Reducing emissions of greenhouse gases.
	Promoting sustainable urbanism
Chile	Increasing the availability of residential buildings with sustainability criteria
	Promoting the implementation of efficient heating, refrigeration and domestic hot water systems.
	Positioning energy efficiency as a nationally important issue
	Increasing the number of subsidies granted by the state for the acquisition of new buildings or for reconditioning of existing buildings with sustainability considerations.
	Creating codes and standards that take local reality into account
Mexico	Financing
	Evaluation of housing
	Defining standards
Peru	Helping lower income layers access social housing
	Optimizing and reducing water consumption
	Optimizing and reducing energy consumption

Fig. 21.3 The most important concerns per country in terms of social housing (Source: Own elaboration)

Ambiente 2014). In addition, the Ministry of the Environment was created, the Peruvian Council for Sustainable Construction, and the technical code for sustainable construction was presented. However, all these measures are positive, but they are still isolated efforts.

Sustainable Building Certifications

The need to massify sustainable construction has led to the emergence of global certification (Fig. 21.4). The vast majority of developed countries have more than one certification. Each certification has criteria and quantifiable indicators to be met (Ching and Shapiro 2014) and has to establish a scale of measurement through compliance with mandatory and optional measures that can be integrated into the design. There are certifications that prioritize one aspect over another; aspects are differentiated by the place of application, consideration of criteria and strategies according to the needs, and conditions of the context (Keeler and Burke 2009).

Criteria		BREEAM	LEED	LBC
Environmental aspects	Contamination	X	X	X
	Materials/Resources	X	X	X
	Waste	X	X	X
	Water	X	X	X
Economic aspects	Life cycle cost	X	X	X
	Stability value			X
Cultural & Social aspects	Security	X		X
	Free access/no barriers			X
	Regional & Social aspects		X	X
Energy	C02 Emissions	X	X	X
	Energy efficiency	X	X	X
	Renewable energy	X	X	X
	Building's energy efficiency	X	X	X
	Fachade/ Covering			X
	Technical Building		X	X
	Services			X
	Power monitoring	X	X	X
	Sub meters and meters	X	X	X
	Electrical services of the building	X	X	X
Comfort & Health	Thermal comfort	X	X	X
	Indoor Quality Environment	X	X	X
	Acoustic comfort	X		X
	Visual comfort	X	X	X
	Occupant control range	X	X	X
Functional aspects	Efficient use of space			X
	Subject to conversions			X
Tecnical aspects	Protection against fire		X	X
	Durability	X		X
	Easy to clean / Maintenance			X
	Resistance to climate and natural disasters			X
Innovation / design	Architecture			X
	Construction of work of art			X
	Innovation	X	X	X
Process management	Design Process	X		X
	Site management	X	X	X
	Commissions	X	X	X
	Operation	X		X
Location	Micro environment	X	X	X
	Traffic connections	X	X	X
	Suitable for cyclists	X	X	X
	Neighbors	X	X	X
	Building regulations			X
	Subject to extensions			X
	Land consumption	X		X
	Conservation of landscape and nature	X	X	X
	Biodiversity	X	X	X

Fig. 21.4 Comparison of criteria used by three different certifications. The author's criteria to make a more detailed comparison of the criteria that are taken into account in each certification have been adapted. The scope and complexity of each of them regarding the sustainability of a building can be observed (Sebastian El Khouli 2015, p. 239) (Source: Own elaboration)

We should therefore consider that the criteria used in developed countries do not necessarily apply to developing countries; therefore, the definition and measurement of these criteria is an essential exploration axis for developing sustainable architecture in each country.

Peru does not have local certification, but the number of buildings that apply to international certifications is increasing. Leadership in Energy and Environmental Design (LEED) has 12 projects certified at national level and approximately 102 projects looking for certification (Peru Green Building Council, s.f.); however, none of them belong to social housing.

However, the overall picture is not favorable. In recent years, strong criticisms have been spoken against certification systems because many buildings qualified as "sustainable" cease to be so when they begin to be occupied. Therefore, not necessarily the fact that they are certified makes them sustainable architectural referents. There are two fundamental problems. First, the sustainable approach is not considered from the start of the project; that is, the building is not thought of as a unit and only new "green" components are added. Second, the building is thought of as isolated; the urban context is not considered, when it should be able to adapt to the existing elements there, such as working on the scales, heights, and so on (Salingaros 2013).

Another issue is that when only optional and mandatory criteria exist, oftentimes only what is strictly necessary to comply with takes place at a minimum, creating aspects that in the long run make the building unsustainable.

Case Study

Classification of Sustainability Criteria for the Case of Social Housing on the Peruvian Coast

There are different ways of grouping sustainability criteria. One way to classify the criteria is through the approach of Anibal Figueroa (2011), who proposes approaching the place first, then designing the building, and finally working with the work management. It also considers aspects such as the health and comfort of users and social criteria such as community participation and adoption of technology. In this case, aspects such as cost factors are addressed tangentially at best or not at all. A similar approach is that of Rojas (2009) that differentiates itself by defining sustainable construction as quality construction, including variables such as life cycle costs, marketability, flexibility, among other criteria. Furthermore, Paredes (2014) goes beyond the life cycle of the material and introduces criteria such as selective disassembly (demolition) and final disposal of materials, among others.

A different approach is proposed by Carlos Hernández (2014), who guides all criteria based on comfort, health, and environmental impact. The socio-economic aspect, the costs, and the understanding of the sociocultural context are not analyzed in depth.

The developed countries are large consumers of energy and CO_2 generators; this situation has influenced some authors to focus on the criteria prioritizing energy efficiency. In developing countries, this aspect is also important, but energy efficiency is not synonymous with sustainability, as it does not solve social-economic problems. Authors like Roufechaei et al. (2014) pose parameters to achieve energy efficiency through passive techniques and efficient water heating, which are easy to apply in some regions of Peru.

These authors do analyze the economic aspect but only partially, or they do not consider it at all. This makes buildings unsustainable over time, and it becomes necessary to solve profitability and the costs of the project because "a building, if more expensive than conventional, is simply not sustainable" (De-Garrido 2011).

Information must be arranged simply if sustainable constructions are to be carried out on massive scales. In this sense, the methodology of the present investigation comprises reviewing and unifying the sustainability criteria from different authors, certifications, and cases in Latin America by arranging them into seven categories and then arranging inside these categories the criteria, sub-criteria, and strategies that can achieve sustainability.

The categories are the subsystems that make up the building: energy, water, materials, site and environment, architectural design, interior environment quality, and social-economic aspects. Although all criteria are related to social, environmental, and economic issues, it was considered necessary the separation of the social-economic criterion for the case of developing countries.

The criteria are more specific ways to meet a category; they are a guideline that allows us to understand on what aspect we must intercede to increase the sustainability of a building. In turn, sub-criteria are various ways of solving the same criteria.

Strategies are more precise indications of how a criterion or sub-criterion can be solved. For example, for the energy criterion, there is a sub-criterion of efficiency, and in order to achieve efficiency, it is necessary to use different active and passive strategies.

With the applied methodology, a list of 31 criteria and 94 sub-criteria, applicable to any building, were obtained. Then, the necessary strategies that can be applied to sustainable social housing in the Peruvian coast under the MiVivienda Sostenible bonus were reviewed, and a list of 25 criteria and 59 sub-criteria was noted down according to their interactions in the fractal

triangle. In addition, the proposed list was compared with programs and policies in Latin America (Programa de las Naciones Unidas Para el Medio Ambiente 2014), and it was found that many of the proposed criteria are starting to be implemented in several countries in the region (Fig. 21.5).

N°	CATEGORY	CRITERIA	SUBCRITERIA	LOCATION
1	01 - Water	1.1. Minimize water usage	1.1.1. Water saving appliances	Ec En
2		1.2. Water reuse	1.2.1. Irrigation	Ec En
3		1.3. Efficient water heating	1.3.1. Energy conservation for water heating	Ec En
4			1.3.2.Heat on demand	Ec En
5		1.4. Water efficient landscape	1.4.1. Efficient irrigation	Ec En
6			1.4.2. Group plants by species	Ec En
7	02 - Indoor Environmental Quality	2.1. Thermal and luminous comfort	2.1.1. Window size	ESE
8			2.1.2. Passive thermal design	ESE
9		2.2. Visual comfort	2.2.1. Biophilia	So En
10			2.2.2. Accesibility to external views	So
11	03 - Architectural Design	3.1. Design for flexibility and adaptability	3.1.1. Expansion and development	So Ec
12		3.2 Compact and efficient design (savings)	3.2.1. High-density	So Ec
13			3.2.2. Space efficiency	So Ec
14		3.3. Ecodesign	3.3.1. Solar Orientation	En So
15			3.3.2. Sustainable construction professional	En So
16	04 - Energy	4.1. Active strategies for Energy Efficiency	4.1.1. Electricity saving - elevators	Ec So
17			4.1.2. Electricity saving - indoor luminaries	Ec So
18			4.1.3. Electricity saving - clothes drying	Ec So
19			4.1.4. Gas saving - home appliances	Ec So
20			4.1.5. Gas saving - gas network	Ec So
21			4.1.6. Efficient lighting - floor to ceiling height	ESE
22			4.1.7. Efficient lighting - exterior luminaries	Ec So
23			4.1.8. Efficient lighting - parking lots and sidewalks	Ec So
24			4.1.9. Efficient lighting - light sensor	Ec So
25			4.1.10. Efficient lighting - common indoor areas	Ec So
26		4.2. Passive strategies for Energy Efficiency	4.2.1. Sunshades in facade	En So
27			4.2.2. Cool roofs	ESE
28		4.3. Local renewable energy	4.3.1. Photovoltaic collectors	En Ec
29			4.3.2. Solar thermal collectors	En Ec
30			4.3.3. Wind power	En Ec
31	05 - Materials	5.1. Chemical and biological quality	5.1.1. Do not use toxic materials	So En
32		5.2. Durability	5.2.1. Durability of surface finishes	En Ec
33			5.2.2. Resistance of the facade to the climate	En Ec
34		5.3. Local materials	5.3.1. Use local materials	ESE
35		5.4. Renewable materials	5.4.1. Use renewable materials	ESE
36		5.5. Recycling	5.5.1. Recyclability of building materials / Recyclable materials / Design for recycling	ESE
37			5.5.2. Uso of recycled materials	ESE
38		5.6. Waste	5.6.1. Waste management plan	ESE
39	06 - Site and environment	6.1. Existing infrastructure	6.1.1. Connection to the community	ESE
40			6.1.2. Interaction of the building with its urban context	ESE
41			6.1.3. Proximity to public transportation	ESE
42			6.1.4. Alternative means of transport	ESE
43		6.2. Protect and restore the environment	6.2.1. Design with nature (natural vegetation)	En So
44			6.2.2. Replant vegetation	En So
45			6.2.3. Permeable flooring	So
46		6.3. Site size	6.3.1. Open green space	So En
47	07 - Social / Economic	7.1. Economic	7.1.1. Poverty relief	ESE
48			7.1.2. Poverty reduction	ESE
49			7.1.3. Affordability (short and long term)	Ec So
50			7.1.4. Low-cost design (loss, size)	Ec So
51			7.1.5. Promoting new employment opportunities - Surveys	So Ec
52			7.1.6. Promoting new employment opportunities - Local workforce	So Ec
53		7.2. Safety	7.2.1. Protection of human welfare	So
54		7.3. Social	7.3.1. Training and use of local labor	So
55			7.3.2. Education for sustainability and replicability - Construction team	So En
56			7.3.3. Education for sustainability and replicability - User communication plan	So En
57			7.3.4. Integration with the community	So Ec
58		7.4. Designing for security	7.4.1. Reduce the chances of theft in the home - Design and enclosures	So Ec
59			7.4.2. Reduce the chances of theft in the home - Space for the guardian	So

Fig. 21.5 Final list of categories, criteria, and sub-criteria (Source: Own elaboration)

Location and Evaluation of Criteria in the Fractal Triangle

A central point to consider when designing a sustainable building is to establish the contribution to the sustainability each criterion can have. However, establishing a value that measures the sustainability of each criterion may seem arbitrary. In order to locate, assign a value, and measure the level of contribution of each criterion to the sustainability of the building, the definition of sustainability itself was considered, which seeks to meet specific needs. Thus, each criterion is evaluated based on what necessity is the one that is being addressed; then, the benefits it directly and indirectly brings are evaluated. The 59 sub-criteria were located according to the variables of the triple bottom line and balancing social, environmental, and economic aspects.

In order to assess the sustainability of each sub-criterion, the fractal triangle model (Braungart and McDonough 2002b) which comprises disaggregating the triangle into smaller ones, identifying interactions of the three variables (social, environmental, and economic), and the central area is the most relevant in the triangle. In the intermediate points, the variables interact differently among themselves (environmental-social, environmental-economic, social-economic, social-environmental, economic-environmental, and economic-social). With this methodology, it is possible to establish that subcriteria cover more than one variable of sustainability and identify which have a greater impact on the sustainability of a project.

The proposed assessment is divided into two aspects: the contribution to the sustainability of the criterion and the priority for the Peruvian case. The first proposes a scoring system that measures the level of contribution of the criterion to each dimension of sustainability. Each criterion can solve the need for a dimension (3 points), generate a direct benefit (2 points), or generate an indirect benefit (1 point); this allows a criterion that meets the need of the three dimensions reach a maximum of 9 points. The second proposes a score system that measures the priority of the criterion for the Peruvian case in four categories: high priority (10 points), high (7.5 points), average (5 points) and low (2.5 points). Finally, input and priority determine two factors that are multiplied to obtain the impact value of the proposed sustainability criterion.

Criterion 4.1.1 can be taken as an example. Saving electricity in elevators would be implemented to address an economic need (3 points), as companies and users would opt for this criterion because they will save money. The second direct achievement for the user is that saving money brings a social benefit (2 points), and finally, saving electricity generates a lower environmental impact (1 point), as it decreases the need for generate more energy at the

CONTIRBUTION TO THE SUSTAINABILITY OF THE PROJECT									FACTOR 1	PRIORITY FOR THE PERUVIAN COAST				FACTOR 2	TOTAL SCORE FACTOR 1 X FACTOR 2
TOP SCORE 9			TOP SCORE 6			TOP SCORE 3				SCORE 10	SCORE 7.5	SCORE 5	SCORE 2.5		
NECESITY			DIRECT BENEFIT			INDIRECT BENEFIT			TOTAL						
Ec	So	En	Ec	So	En	Ec	So	En		VERY HIGH 10	HIGH 7.5	MEDIUM 5	LOW 2.5	TOTAL PERU	
3	0	0	0	2	0	0	0	1	6	0	7.5	0	0	7.5	45

Fig. 21.6 Table matrix for evaluation of sustainability sub-criteria (Source: Own elaboration)

source, which is usually obtained through fuel. With these values, the contribution to sustainability would add 6 points. However, the priority for the Peruvian case was determined as high (7.5 points). If we multiply both values, we can determine that the impact value of the proposed sustainability criterion is 45 points. Figures 21.6, 21.7, and 21.8 present a table matrix for evaluation of sustainability sub-criteria, triangle of sustainability classification, and a table of sub-criteria.

After using the sub-criteria valuation matrix, we obtain two variables to interpret: the accumulated score and the average contribution level for each criterion (Fig. 21.9). For the case of the accumulated score, we can conclude that the category that represents the highest amount of accumulated score is the social-economic category, followed by the energy category. This is because both categories have a greater number of sub-criteria. However, when verifying the level of contribution or average score of sub-criteria by category, we can see that the category in which the sub-criteria has the highest value is the water category, followed by social-economic, site and environment, and materials.

It is necessary to emphasize that, for the Peruvian case, the categories that represent a greater contribution to the sustainability of the project are those that should be considered with greater attention (Fig. 21.10). In this sense, the water category is the most relevant to measure the sustainability of a home, since each sub-criterion has an average of 65 points, with sub-criteria reaching up to 80 points. The second most important category to consider is the social-economic one, with an average contribution of 63.8 points. Following this is the category of site and environment, with a minimum difference in average contribution that equals 63.4 points. After this, the categories of materials follow with a contribution of 57.8, energy with 43, environmental quality with 41.3, and finally, architectural design with the lowest average contribution of 41 points.

The graphs (Fig. 21.10) show the total percentage of contribution of each category, the total score of each category, and the average contribution of each sub-criterion by way of summary. In addition, the rating or score of each category can be verified graphically.

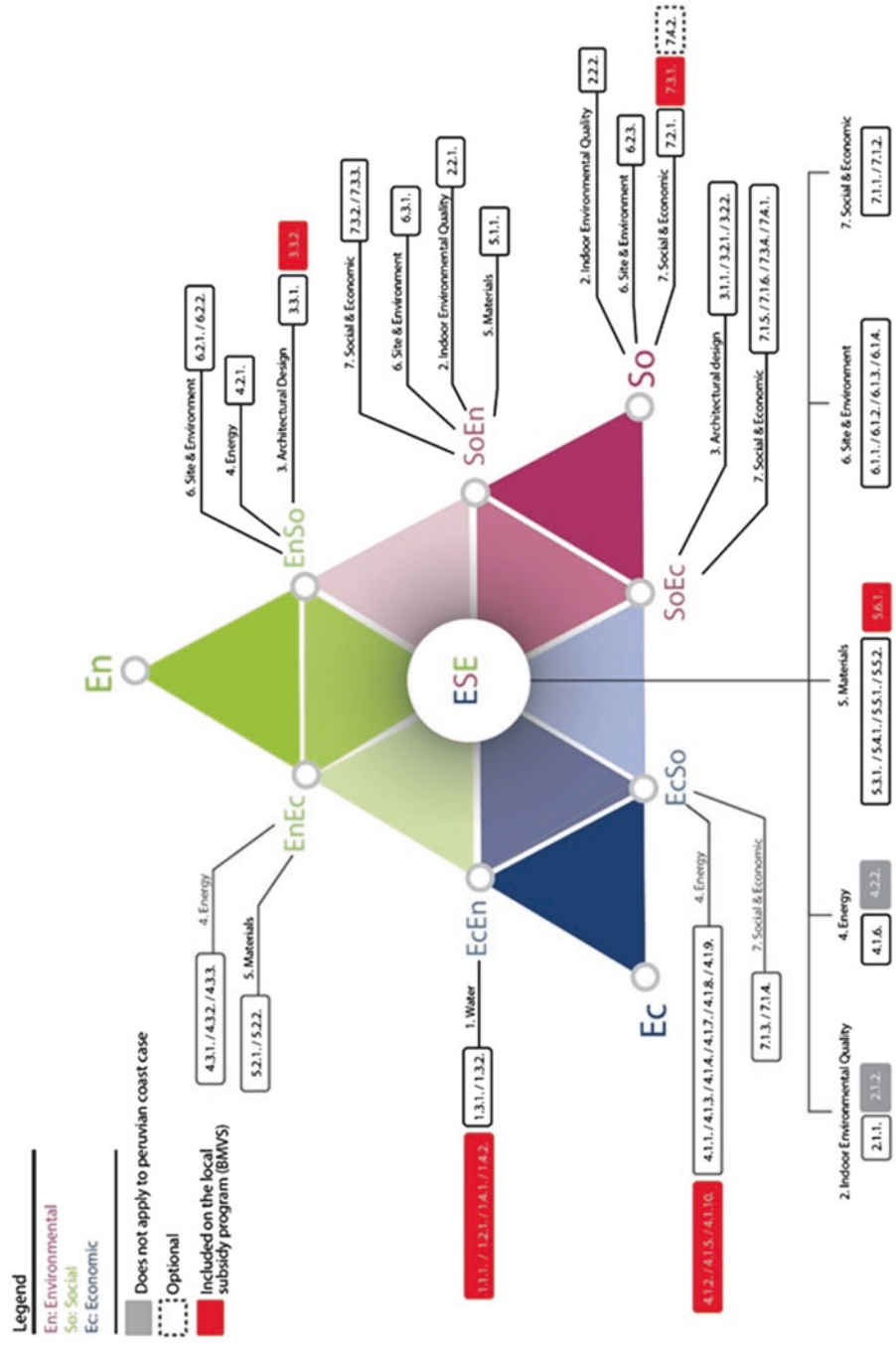


Fig. 21.7 Triangle of classification of sustainability (Source: Own elaboration)

			CONTRIBUTION TO THE SUSTAINABILITY OF THE PROJECT										PRIORITY FOR THE PERUVIAN COAST					TOTAL SCORE
			SOCIETY			DIRECT BENEFIT			INDIRECT BENEFIT									
CATEGORY	SUBCRITERIA	LOCATION IN TRIANGLE	Ec	So	En	Ec	So	En	Ec	So	En	TOTAL	VERY HIGH 10	HIGH 7.5	MEDIUM 5	LOW 2.5	TOTAL PERU	
01 - Water	1.1.1. Water saving appliances	Ec En	3	0	0	0	2	2	0	0	0	7	10	0	0	0	10	70
	1.2.1. Irrigation	Ec En	3	0	0	0	2	2	0	0	0	7	10	0	0	0	10	70
	1.3.1. Energy conservation for water heating	Ec En	3	0	0	0	0	2	0	1	0	6	10	0	0	0	10	60
	1.3.2.Heat on demand	Ec En	3	0	0	0	0	2	0	1	0	6	10	0	0	0	10	60
	1.4.1. Efficient irrigation	Ec En	3	0	0	0	2	2	0	0	0	7	10	0	0	0	10	70
	1.4.2. Group plants by species	Ec En	3	0	0	0	0	2	0	1	0	6	10	0	0	0	10	60
02- Indoor Environmental Quality	2.1.1. Window size	ESE	0	3	3	2	0	0	0	0	0	8	0	7.5	0	0	7.5	60
	2.1.2. Passive thermal design	ESE	0	3	3	2	0	0	0	0	0	8	0	7.5	0	0	7.5	60
	2.2.1. Biophilia	So En	0	3	0	0	0	2	0	0	0	5	0	0	5	0	5	25
	2.2.2. Accesibility to external views	So	0	3	0	0	0	0	0	0	1	4	0	0	5	0	5	20
03 - Architectural Design	3.1.1. Expansion and development	So Ec	0	3	0	2	0	0	0	0	1	6	0	0	5	0	5	30
	3.2.1. High-density	So Ec	3	0	0	0	0	0	0	1	1	5	0	0	5	0	5	25
	3.2.2. Space efficiency	So Ec	0	3	0	2	0	0	0	0	1	6	0	7.5	0	0	7.5	45
	3.3.1. Solar Orientation	En So	0	3	3	2	0	0	0	0	0	8	0	7.5	0	0	7.5	60
	3.3.2. Sustainable construction professional	En So	0	0	0	2	2	2	0	0	0	6	0	7.5	0	0	7.5	45
04 - Energy	4.1.1. Electricity saving - elevators	Ec So	3	0	0	0	2	0	0	0	1	6	0	7.5	0	0	7.5	45
	4.1.2. Electricity saving - indoor luminaries	Ec So	3	0	0	0	2	0	0	0	1	6	0	7.5	0	0	7.5	45
	4.1.3. Electricity saving - clothes drying	Ec So	3	0	0	0	2	0	0	0	1	6	0	0	5	0	5	30
	4.1.4. Gas saving - home appliances	Ec So	3	0	0	0	2	0	0	0	1	6	0	0	5	0	5	30
	4.1.5. Gas saving - gas network	Ec So	3	0	0	0	2	0	0	0	1	6	0	0	5	0	5	30
	4.1.6. Efficient lighting - floor to ceiling height	ESE	3	0	0	0	2	0	0	0	1	6	0	0	5	0	5	30
	4.1.7. Efficient lighting - exterior luminaries	Ec So	3	0	0	0	2	0	0	0	1	6	0	0	5	0	5	30
	4.1.8. Efficient lighting - parking lots and sidewalks	Ec So	3	0	0	0	2	0	0	0	1	6	0	0	5	0	5	30
	4.1.9. Efficient lighting - light sensor	Ec So	3	0	0	0	2	0	0	0	1	6	0	0	5	0	5	30
	4.1.10. Efficient lighting - common indoor areas	Ec So	3	0	0	0	2	0	0	0	1	6	0	0	5	0	5	30
	4.2.1. Sunshades in facade	En So	0	3	0	0	0	2	1	0	0	6	0	7.5	0	0	7.5	45
	4.2.2. Cool roofs	ESE	3	3	0	0	0	2	0	0	0	8	0	7.5	0	0	7.5	60
	4.3.1. Photovoltaic collectors	En Ec	3	0	3	0	0	0	0	1	0	7	10	0	0	0	10	70
	4.3.2. Solar thermal collectors	En Ec	3	0	3	0	0	0	0	1	0	7	10	0	0	0	10	70
	4.3.3. Wind power	En Ec	3	0	3	0	0	0	0	1	0	7	10	0	0	0	10	70
05 - Materials	5.1.1. Do not use toxic materials	So En	0	3	3	0	0	0	1	0	0	7	10	0	0	0	10	70
	5.2.1. Durability of surface finishes	En Ec	3	0	3	0	0	0	0	1	0	7	0	0	5	0	5	35
	5.2.2. Resistance of the facade to the climate	En Ec	3	0	3	0	0	0	0	1	0	7	0	0	5	0	5	35
	5.3.1. Use local materials	ESE	3	3	3	0	0	0	0	0	0	9	0	7.5	0	0	7.5	67.5
	5.4.1. Use renewable materials	ESE	0	0	3	2	2	0	0	0	0	7	10	0	0	0	10	70
	5.5.1. Recyclability of building materials / Recyclable materials / Design for recycling	ESE	0	0	3	2	2	0	0	0	0	7	0	7.5	0	0	7.5	52.5
	5.5.2. Uso of recycled materials	ESE	0	0	3	2	2	0	0	0	0	7	0	7.5	0	0	7.5	52.5
	5.6.1. Waste management plan	ESE	0	3	3	2	0	0	0	0	0	8	10	0	0	0	10	80
06 - Site & Environment	6.1.1. Connection to the community	ESE	3	3	0	0	0	2	0	0	0	8	10	0	0	0	10	80
	6.1.2. Interaction of the building with its urban context	ESE	3	3	0	0	0	2	0	0	0	8	10	0	0	0	10	80
	6.1.3. Proximity to public transportation	ESE	3	3	0	0	0	2	0	0	0	8	10	0	0	0	10	80
	6.1.4. Alternative means of transport	ESE	3	3	0	0	0	2	0	0	0	8	10	0	0	0	10	80
	6.2.1. Design with nature (natural vegetation)	En So	0	3	3	0	0	0	1	0	0	7	0	7.5	0	0	7.5	52.5
	6.2.2. Replant vegetation	En So	0	3	3	0	0	0	0	0	0	6	0	7.5	0	0	7.5	45
	6.2.3. Permeable flooring	So	0	0	3	0	0	0	1	1	0	5	0	7.5	0	0	7.5	37.5
	6.3.1. Open green space	So En	0	3	3	0	0	0	1	0	0	7	0	7.5	0	0	7.5	52.5
07 - Social / Economic	7.1.1. Poverty relief	ESE	3	3	3	0	0	0	0	0	0	9	10	0	0	0	10	90
	7.1.2. Poverty reduction	ESE	3	3	3	0	0	0	0	0	0	9	10	0	0	0	10	90
	7.1.3. Affordability (short and long term)	Ec So	3	3	0	0	0	0	0	0	1	7	10	0	0	0	10	70
	7.1.4. Low-cost design (loss, size)	Ec So	3	3	0	0	0	0	0	0	1	7	10	0	0	0	10	70
	7.1.5. Promoting new employment opportunities - Surveys	So Ec	3	3	0	0	0	0	0	0	1	7	10	0	0	0	10	70
	7.1.6. Promoting new employment opportunities - Local workforce	So Ec	3	3	0	0	0	0	0	0	1	7	10	0	0	0	10	70
	7.2.1. Protection of human welfare	So	0	3	0	0	0	0	1	0	1	5	10	0	0	0	10	50
	7.3.1. Training and use of local labor	So	0	3	0	2	0	0	0	0	1	6	0	7.5	0	0	7.5	45
	7.3.2. Education for sustainability and replicability - Construction team	So En	0	3	3	0	0	0	1	0	0	7	10	0	0	0	10	70
	7.3.3. Education for sustainability and replicability - User communication plan	So En	0	3	3	0	0	0	1	0	0	7	10	0	0	0	10	70
	7.3.4. Integration with the community	So Ec	0	3	0	2	0	0	0	0	1	6	0	7.5	0	0	7.5	45
	7.4.1. Reduce the chances of theft in the home - Design and enclosures	So Ec	0	3	0	2	0	0	0	0	1	6	0	7.5	0	0	7.5	45
	7.4.2. Reduce the chances of theft in the home - Space for the guardian	So	0	3	0	2	0	0	0	0	1	6	0	7.5	0	0	7.5	45
																		3205

Fig. 21.8 Table of evaluation of sub-criteria according to fractal triangle (Source: Own elaboration)

Criteria Evaluation Methodology

The category with the highest number of criteria to assess is the category of materials, followed by water and social-economic. This is relevant to the Peruvian case because these three criteria should be evaluated with greater attention. The categories that have the lowest number of criteria are indoor

	Summed score	Amount of sub criteria	Average contribution level per sub-criteria
01 - Water	390	6	65.0
02- Indoor wnvironmental quality	165	4	41.3
03 - Architectural design	205	5	41.0
04 - Energy	645	15	43.0
05 - Materials	462.5	8	57.8
06 - Site & Environment	507.5	8	63.4
07 - Social / Economic	830	13	63.8
TOTAL SCORE TO REACH	3205	59	54.3

Fig. 21.9 Comparative table of scores and level of contribution of each sub-criterion (Source: Own elaboration)

environment quality, energy, and site and environment, contrary to international certifications, where the category of energy is usually the one considered by most criteria. This relationship does not imply that categories with fewer criteria are less important because it is necessary to comply with all categories equally.

When the sub-criteria are revised, energy category has the most sub-criteria, followed by social-economic. In all cases, the number of sub-criteria is greater than the criteria. For example, the case of the water category can be reviewed in criterion 1.3 (Fig. 21.11) efficiency of hot water; here are two sub-criteria to meet the criterion: avoid the loss in the route and heat on demand.

To achieve the objective of the criterion and sub-criteria, a methodology must be applied to evaluate its compliance. The methodology determines those points that need to be measured in order to verify if the sub-criterion is being met or not. The creation of a methodology is not an objective of this study, but to identify one that may be adapted to the Peruvian case.

The proposed evaluation methodology, as well as the determination of the criteria and sub-criteria, began with the review of evaluation methods published by different authors, certifications, and examples in Latin America. In some cases, the methodology is adapted and some changes are introduced; in other cases, the original methodology is used directly. This methodology has been plotted in cards, which have been used to evaluate the nine projects of the MiVivienda Sostenible bonus (Fig. 21.12).

MiVivienda Sostenible Bonus

Using the criteria and sub-criteria proposed for sustainable social housing on the Peruvian coast, the nine projects interested in acquiring the MiVivienda Sostenible bonus during the years 2015–2016 were analyzed, and it was

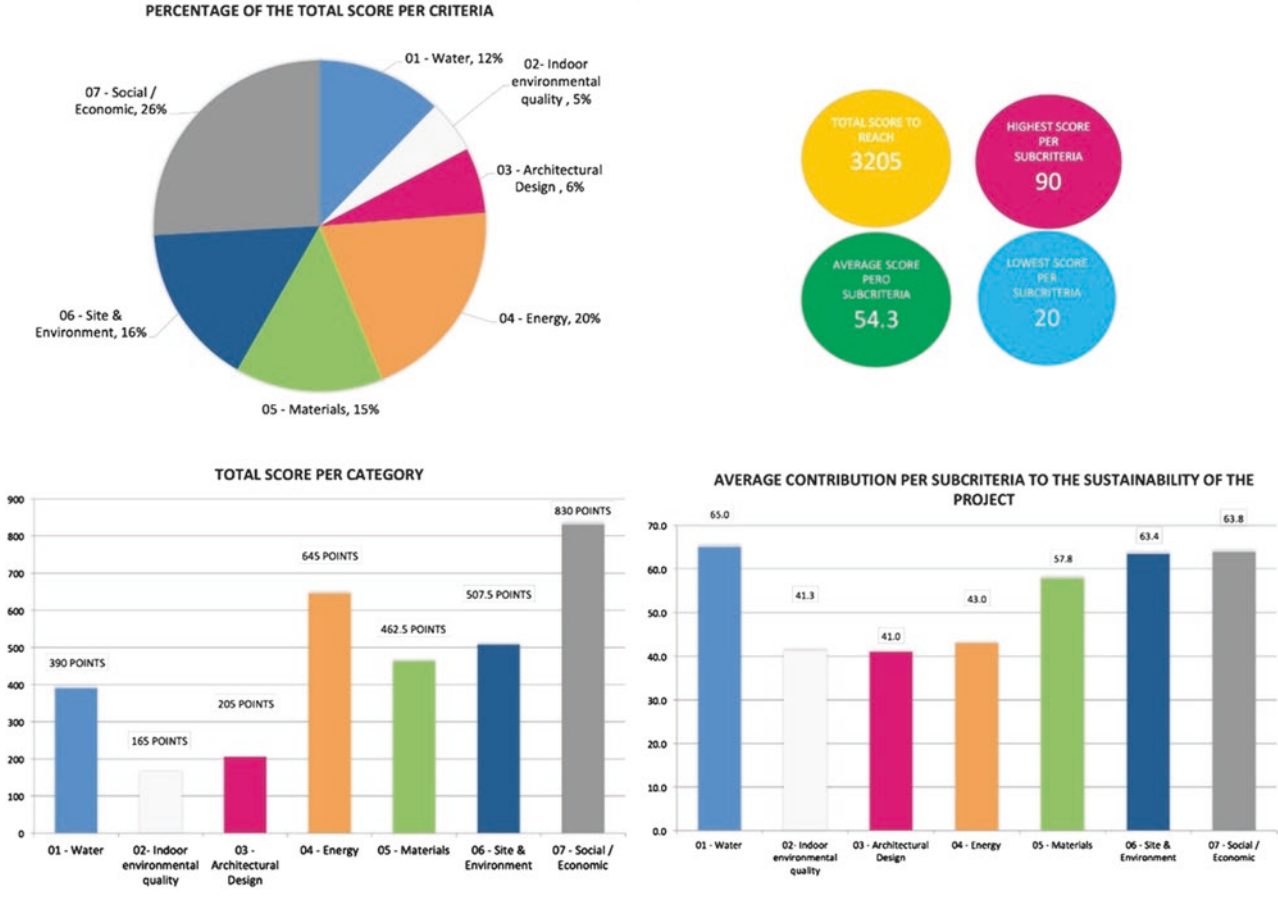


Fig. 21.10 Level of contribution of sub-criteria, according to the seven categories proposed for the analysis of a sustainable housing in the Peruvian coast (Source: Own elaboration)

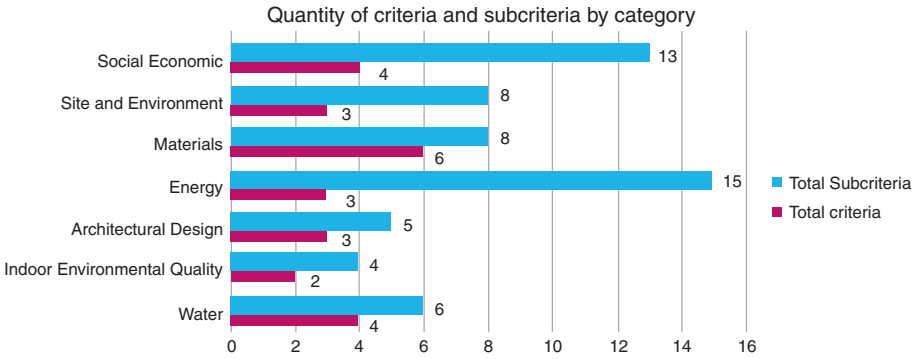


Fig. 21.11 Relationship between criteria and sub-criteria by category (Source: Own elaboration)

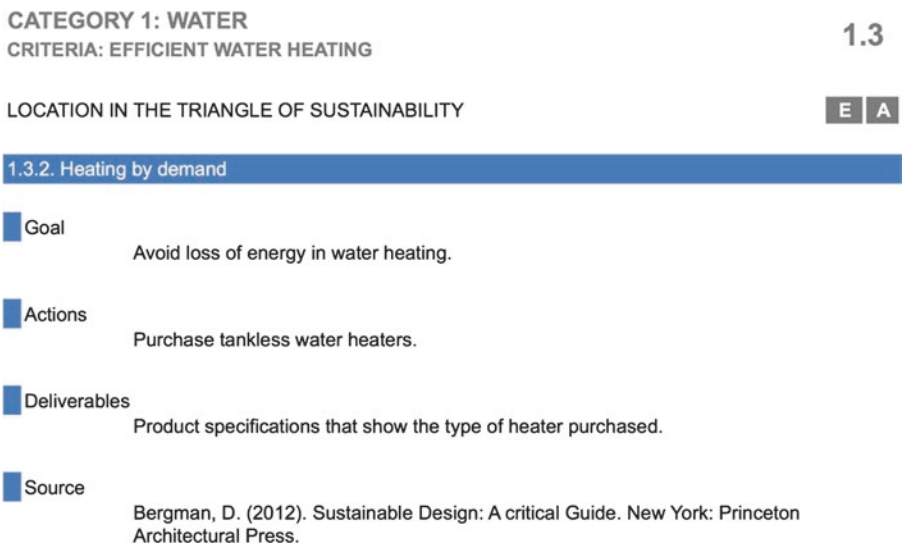


Fig. 21.12 Card header example (Source: Own elaboration)

CATEGORY	CRITERIA EVALUATION			
	Qualified	Not qualified	L.I.	Total
	N°	N°	N°	N°
WATER	20	11	24	55
INDOOR ENVIRONMENTAL QUALITY	20	15	0	35
ARCHITECURAL DESIGN	23	13	9	45
ENERGY	20	52	64	129
MATERIALS	9	0	63	72
SITE & ENVIRONMENT	31	20	20	71
SOCIAL & ECONOMIC	11	0	106	117
TOTAL	134	111	286	524

Fig. 21.13 Summary table of sub-criteria evaluated by categories in the nine bonus projects (Source: Own elaboration)

possible to assess their level of sustainability. The objective is to be able to apply the methodology to the nine projects that have proposed this loan (which add up to 531 sub-criteria, considering 59 per project) and to establish if the sub-criterion is met, if it is not met, or if information is missing. Another objective is to establish patterns by category, criterion, or sub-criteria, in order to detect which ones must be reinforced and developed or which are being correctly conducted. Figure 21.13 shows by category the total of sub-criteria evaluated, the amount it meets, the amount it does not meet, and what is missing information. In addition, in Fig. 21.14, we can verify the quantities and percentages by category.

Figure 21.15 shows the summary of all the sub-criteria evaluated in each project according to their location in the triangle and determine which ones meet, which ones do not meet, and which information is missing. Out of the total criteria evaluated in the nine projects of the MiVivienda Sostenible bonus, 54 percent could not be evaluated due to lack of information, either because the company did not submit the required documentation or because they do not have such information.

As can be seen in Fig. 21.15, 134 criteria corresponding to 25 percent do comply with the evaluation. Site and environment is the one that contributes most to this result, since the information necessary for the evaluation is almost indispensable for all projects. However, the opposite happens with the social-economic aspect, since only eight percent of the 117 criteria evaluated in this sector comply with the evaluation. This happens in all projects, since the criteria are not considered in the evaluation to access the bonus; therefore, there is no information.

On the contrary, 21 percent of the evaluated criteria that correspond to a total of 111 do not comply because many of them are new and are not included in the bonus and actions to meet these criteria are very specific and very few achieve them.

If we disaggregate these figures some more and verify how the criteria evaluated develop by taking into account the place of the fractal triangle, we find some interesting data, as depicted in Fig. 21.16. In most of the categories, the lack of information is evident, especially in the economic-social and social-economic part, where the information gap becomes more than half of the criteria evaluated (Fig. 21.17).

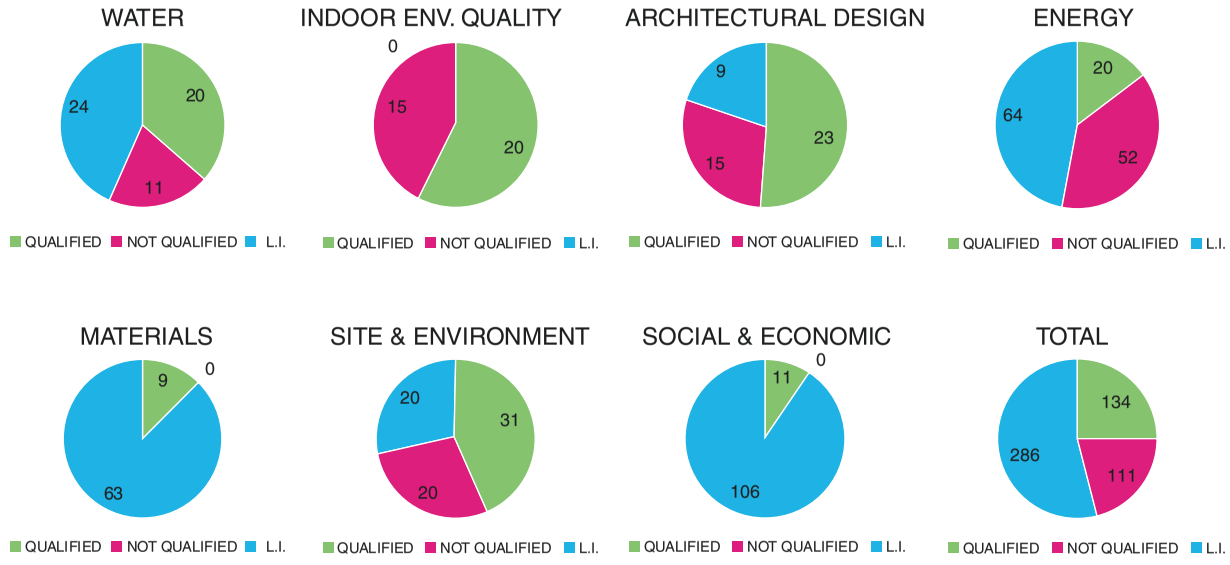


Fig. 21.14 Summary of evaluation of criteria by projects, according to categories (Source: Own elaboration)

CATEGORY	Qualified			Not qualified			Lack of information		
	N°	% SI	% TOTAL	N°	%	% TOTAL	N°	%	% TOTAL
So	17	13%	3%	10	9%	2%	18	12%	3%
SoEc	19	14%	4%	8	7%	2%	36	10%	7%
EcSo	12	9%	2%	14	13%	3%	73	8%	14%
Ec	0	0%	0%	0	0%	0%	0	0%	0%
EcEn	20	15%	4%	10	9%	2%	24	12%	5%
EnEc	0	0%	0%	27	24%	5%	18	13%	3%
En	0	0%	0%	0	0%	0%	0	4%	0%
SoEn	14	10%	3%	5	5%	1%	26	8%	5%
EnSo	5	4%	1%	14	13%	3%	26	8%	5%
ESE	47	35%	9%	23	21%	4%	65	26%	12%
TOTAL CRITERIA	134	100%	25%	111	100%	21%	286	100%	54%
							TOTAL SUB-CRITERIA		531

Fig. 21.15 Summary evaluation of sub-criteria of each project, according to its location in the fractal triangle (Source: Own elaboration)

Lessons Learned

After studying the situation of sustainability in Peru in a local context, it was found that unlike Chile and Mexico, Peru does not have a national strategy that holistically embraces sustainability, nor does it focus its efforts on priority issues as does Argentina (energy efficiency) or Colombia (reduction of greenhouse gas emissions); it has not developed sustainable building certifications adequate to the local context and applicable to the social housing sector as did Brazil.

With regard to laws, regulations, and programs in the country, it can be verified that the efforts are aimed at helping the lower-income group to access social housing, optimizing and reducing water and energy consumption, and improving waste disposal, leaving aside sustainability variables linked to other aspects such as building materials, quality of the interior environment, and architectural design. In the nine cases analyzed in the MiVivienda Sostenible bonus, there is a lack of information that does not allow—under the methodology presented—affirming that social housing programs in Peru can be called sustainable or even recognize the positive impact that the bonus means in search of sustainability in Peru.

The proposal of choosing criteria and sub-criteria is not definitive; it allows adaptability to different contexts and introducing new variables thereto. It is possible to adapt it for the other regions of Peru and Latin America. The evaluation method also allows adaptability, and the variables of each context, especially when the priority is defined for each case, must be taken into consideration.

According to the proposed list of criteria, only eight percent address only one dimension of sustainability; in contrast, 25 percent of sub-criteria belong to the central part of the fractal triangle, so they are more relevant to the sustainability of a project. Of the sub-criteria, 19 percent are located in the

Fig. 21.16 Evaluation of criteria according to interaction in the fractal triangle (Source: Own elaboration)

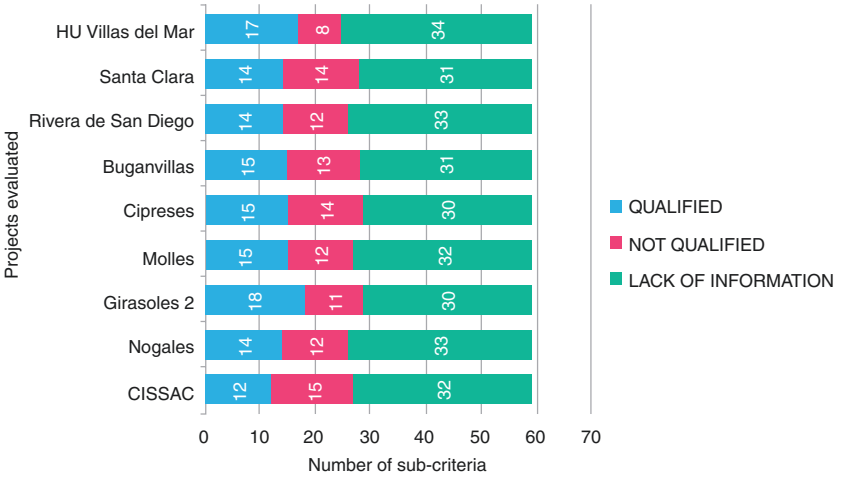


Fig. 21.17 Evaluation of the projects of the companies interested in acquiring the MiVivienda Sustainable bonus using sub-criteria (Source: Own elaboration)

economic-social sector (they serve economic needs and affect the social level directly or indirectly). This is the case of the energy sub-criterion, which involves long-term energy savings and therefore less expense and higher performance of the building. In the economic-environmental, environmental-economic, environmental-social, and social-environmental categories, these encompass about ten percent of each sub-criteria.

It can be concluded that for the case of social housing on the Peruvian coast, the variables must be more efficient because there are limited resources. Therefore, the classification proposal highlights those variables that serve more than one dimension of sustainability, with emphasis on the social variable.

Challenges and Barriers

The remaining challenges for sustainability in social housing in developing countries are firstly related with understood the real needs of each country, including the projection of growth (future needs) in order to devise strategies in line with its reality.

This is not a simple task, because many times, it is simpler to import models from developed countries, prioritizing aspects that are foreign to the local reality. The policies of each country must start from the local level and then look at the policies on the global level, and adapt those measures that are considered

relevant. In many countries of the region, including Peru, there is still a vacuum in the legislature that encourages sustainable construction.

On a local dimension, the program of sustainable social housing in Peru is oriented to the coast that concentrates more than 50 percent of the population; nevertheless, the sustainable building is necessary as much in the highland region as in the jungle region, because they are ecosystems which are highly vulnerable. It is necessary to promote social housing programs oriented to each region and studies that support them with the election of sustainable criteria.

In this sense, research and education on sustainability issues should be strengthened in universities and even in schools. The awareness of professionals involved in construction and citizens is a slow but very powerful engine of change. There is little research that measures environmental impacts on small-scale buildings and evaluates the sustainability of projects and in order to obtain a greater success on sustainable design and construction this issue should be promoted.

Acknowledgments This research has been possible, thanks to the support of the Institute of Scientific Research from the University of Lima. We are also grateful to the research fellows Rocío del Carmen Diestra Villavicencio and Claudia María Gómez Diaz.

References

Banco Interamericano de Desarrollo. 2012. *Estudio del BID: América Latina y el Caribe encaran creciente déficit de vivienda*. http://www.iadb.org/es/noticias/comunicados-de-prensa/2012-05-14/deficit-de-vivienda-en-america-latina-y-el-caribe,9978.html. Accessed 16 Marzo 2017.

Braungart, M., and W. McDonough. 2002a. *Cradle to Cradle*. New York: North Point Press.

———. 2002b. Design for the Triple Top Line: New Tools for Sustainable Commerce. *Corporate Environmental Strategy* 9 (3): 253.

Cárdenas Jirón, L.A. 1999. Definición de un marco teórico para comprender el concepto del desarrollo sustentable. *Revista de Urbanismo* 1: 1.

Ching, F.D., and I. Shapiro. 2014. *Green Building Illustrated*. Hoboken: John Wiley and Sons.

Colegio de Arquitectos del Perú. 2012. *caplima.pe*. http://caplima.pe/PortalCap/mision_vision.aspx. Accessed 1 Junio 2016.

De Garrido, L. 2009. *Análisis de proyectos de arquitectura sostenible: Naturalezas artificiales 2001–2008*. Madrid: McGraw-Hill.

———. 2011. *Entrevista Luís de Garrido* (G. AUGUSTO PELAIO, Entrevistador). Obtenido de http://www.vitruvius.com.br/revistas/read/entrevista/12.046/3793.
Figueroa Castrejón, A. 2011. *Estudios de arquitectura bioclimática.* México: Universidad Autónomo Metropolitana.
Hernández Pezzi, C. 2014. *Un vitrubio ecológico*. Barcelona: Gustavo Gili.
INEI. 2015. *Hogares con déficit cuantitativo de vivienda*. Lima: INEI.
Keeler, M., and B. Burke. 2009. *Fundamentals of Integrated Design for Sustainable Building*. Hoboken: John Wiley and Sons Inc.
Miguel, S.A. 2010. *Arquitectura sustentable: Proyecto social en sectores marginales.* Bogotá: Nobuko.
MiVivienda, F. 2014. *Reglamento del Bono MiVivienda Sostenible*.
Ozolins, P. 2014. *Sustainability and Scarcity*. Abingdon/Oxford/New York: Taylor & Francis/Routledge.
Paredes Benitez, C. 2014. *Ideas para una casa ecológica*. Madrid: Ilus Books.
Pérez Pérez, A. 2013. *Bases para el diseño de la vivienda de interés social: según las necesidades y expectativas de los usuarios*. Bogotá: Universidad de La Salle.
Programa de las Naciones Unidas para el Medio Ambiente. 2014. *Situación de la Edificación Sostenible en América Latina.* México: PNUMA.
Rojas, T. 2009. *Cómo buscar el crecimiento sostenible de vivienda social ofreciendo un producto estandarizado, modular y económico*. Lima/Madrid: Pontificia Universidad Católica del Perú. Universidad Politécnica de Madrid.
Roufechaei, K., A. Hassan Abu Bakar, and A. Tabassi. 2014. Energy-Efficient Design for Sustainable Housing Development. *Journal of Cleaner Production* 65: 380–388.
Salingaros, M.M. 2013. http://www.archdaily.pe/pe/02-276919/por-que-la-arquitectura-verde-pocas-veces-merece-su-nombre.
Saura i Craulla, C. 2003. *Arquitectura y medio ambiente.* Editorial de la Universitat Politècnica de Catalunya.
Sebastian El Khouli, J.V. 2015. *Sustainable Construction Techniques.* Institut fur Internationale Architektur-Dokumentation.
The American Institute of Architects. 2013. *http://www.aia.org*/. http://www.aia.org/education/ces/AIAB089084. Accessed 1 Junio 2016.
World Commission on Environment and Development. 1987. *Our Common Future.* Oxford: OUP.
Zander, M. 2009. El valor bioclimático de la vivienda. *Directivos Construcción*, 60–61.

22

Treehugger Organic Farm: Visions for Small-Scale, Sustainable Agriculture in Broward, Florida

Thelma I. Velez

Background

The Legacy of the Green Revolution

To comprehend the importance of small-scale, sustainable agriculture, particularly in urban environments, it is crucial to first understand recent historical trends in agriculture, in addition to, criticisms of the conventional model dominating food production in the global economy today. The latter half of the twentieth century marked a dramatic shift in the structure of agriculture across the United States and abroad. The adoption and diffusion of new technologies skyrocketed in the twentieth century with the green revolution. Increased mechanization reduced the need for intensive farm labor, the creation of new synthetic fertilizers and pesticides produced greater yields (and a dependence paradigm), and a variety of government policies, such as subsidies or insurance schemes, encouraged monoculture (one crop) systems.

Today, the landscape of modern agriculture is dominated by rural, industrial farms reflecting the legacy of the green revolution. The adoption of new technologies allowed farmers with capital and access to increase and intensify production and expand their farming systems. What occurred subsequently

T. I. Velez (✉)
School of Environment and Natural Resources, The Ohio State University, Columbus, OH, USA

R. Brinkmann, S. J. Garren (eds.), *The Palgrave Handbook of Sustainability*,
https://doi.org/10.1007/978-3-319-71389-2_22

has been coined the agricultural treadmill. In short, it is a process by which a farmer must continually adopt new technologies in order to maintain a profit or risk losing their farm. Many scholars have attributed the decline in family farming operations and the consolidation of farmland to the ubiquity of green revolution innovations (Carolan 2016).

The number of new farmers has been steadily decreasing for several decades. In 1935 the number of family farms in the U.S. neared 6.8 million, yet by 2012 there were only 2.1 million (United States Department of Agriculture Economic Research Service [ERS], 2017). Even with such stark decreases in the number of farming families, the amount of land in production has been relatively stable. The average farm size has more than doubled between 1950 and 2000 (Lobao and Meyer 2001). The caveat is that larger industrial farms have come to dominate the landscape.

In 2015, small farms with sales under $10,000 made up almost half of all US farms, but only one percent of national production, while 0.3 percent of farms accounted for over half of national production (ERS 2016a, b). Many small farmers have been pushed out of business, or are forced to work off-farm to make ends meet. For those with farming backgrounds, it comes as no surprise that 42 percent of small farm operators in the United States must maintain off-farm employment (ERS 2016a, b). Scholars have confirmed small farmers often self-exploit in order to keep their farms operating. Farmers frequently reduce external labor and work long days themselves without pay (Guthman 2014). The most profitable farming businesses tend to enter into contracts with corporations to produce one type of crop or livestock at a fixed, non-negotiable price (Hinrichs and Lyson 2007; Lewontin 1998). This strategy has been sustained with government subsidies, crop insurance, and other distorting policies encouraging production of particular crops, such as corn and soybean, the two most widely planted crops in the United States (Eubanks 2009).

Ecological Repercussions of the Green Revolution

The green revolution led to more than just structural changes in agriculture; the ecological repercussions have been just as bleak (Tilman 1998). One of the most concerning ecological problems posed by modern agriculture is the loss and degradation of soil resulting from poor practices. Soil is the foundation of life on a farm. Crops, both for human and animal consumption, require healthy soils. Soil tilling, perhaps the most ubiquitous practice on farmlands today, is also one of the most destructive (Gleissman et al. 1998). Tilling destroys soil macro- and micro-organisms and diminishes soil health characteristics,

leaving turned, dry soil to runoff with rain, be dispersed by wind, or crust over (Gleissman 1992). The rate of soil loss since the introduction of mechanized tillage practices on farms has been unprecedented. In order to compensate for nutrient losses, most farmers invest in fertilizers to replenish the soil. Prior to the introduction of synthetic fertilizers, farmers were careful to nurture soil using composted manure and allowed plant biomass residue to naturally decompose. These methods have been proven to provide nutrients and build up soil organic matter (Reeves 1997).

As farmers increase fertilizer application, excess nutrients (primarily nitrogen and phosphorus) run off into waterways causing greater problems off the farm. When high loads of nutrients are introduced into waterways, algal growth accelerates leading to a process known as eutrophication. Eutrophication results in the growth of algal blooms which consume oxygen in the water bodies leading to hypoxic (low oxygen) or anoxic (no oxygen) zones. Algal blooms have been on the rise for decades and have been reported in water bodies near agricultural areas across the world (Michalak et al. 2013). In the US, the Toledo Crisis is a prime example on how the accumulation of toxic algae has repeatedly disrupted life on, in, and near Lake Erie (Wines 2014). Algal blooms are a human health problem linked to diarrhea, vomiting, and liver damage (Jetoo et al. 2015). Yet, deadly algal blooms are not just a human health issue. Wildlife, like humans, need water and oxygen to survive. When waterways become oxygen deficient, aquatic species suffocate, and terrestrial species do not have access to drinkable water. Sustainable agriculture promotes conservation practices to protect soil and reduce runoff, while also promoting the elimination or reduction of synthetic fertilizer application.

Pesticide toxicity is yet another problem plaguing agricultural workers, consumers, and wildlife. The risks of pesticides became most apparent in the 1960s when Rachel Carson released her book, *Silent Spring*, which exposed the link between pesticides, cancer, and declining wildlife populations (Carson 1962). Recent studies have demonstrated that agricultural workers who are frequently tasked with applying pesticides have disproportionately high rates of several forms of cancer when compared to the general population and other farm workers (National Cancer Institute 2011; Mills and Shah 2014). Research has found that conventionally grown produce is laced with pesticide residue that can be harmful when consumed in high quantities. The use of pesticides is extremely detrimental to wildlife living near farms as well. The most widely used pesticides are indiscriminate and their prevalence has been linked to the declines of pollinator species critical to agricultural production (Pettis et al. 2013; Ollerton et al. 2014; Henry et al. 2012).

Another ecological concern of industrial agriculture is the rise of monoculture farms. Continuous planting of single crop varieties has been proven to exhaust soil nutrients and have negative consequences on soil microbiology (Figuerola et al. 2015). There are hundreds to thousands of varieties for each major crop, yet only a select few ever enter into the global market and dominate. While having a single crop is easier to manage, the prevalence of monoculture farms has led to a decline in biological diversity, which has both ecological and cultural repercussions (Altieri 1999; Jacques and Jacques 2012). As crop diversity on farms has decreased, the dependence on chemical control for diseases and pests has risen. When a crop disease occurs on a farm, it is often accompanied by a significant, if not total, loss for farmers who grow a single crop variety, as was the case with the Irish potato famine in the 1840s (University of California Berkeley 2017). Having a farm with a diverse array of crop varieties and intercropped species reduces the chance that a farmer will lose all of their crops in a season marked by high pests or disease (Altieri 1999).

Intercropping is a technique that introduces biodiversity and also prevents the depletion of soil nutrients (Wang et al. 2014). The use of polyculture guilds is one example of intercropped systems that work synergistically to increase crop yield and nurture soil. Intercropping and polyculture guilds have been proven to exceed yields when compared to monoculture systems (Gleissman 1992; Tsubo et al. 2003). In the Americas, early traditional knowledge led to the corn-bean-squash polyculture system, which has been studied widely. Beans fix nitrogen in the soil for the corn, which in turn provides structure for the beans to trellis, while squash acts as a living mulch, shading soil and reducing the need for irrigation (Postma and Lynch 2012; Liebman and Dyck 1993). Today it is understood that each crop has unique nutrient needs and root structures which encourage higher yields when strategically planted together.

Farmers in rural, suburban, and urban areas have been incorporating sustainable agricultural practices as a response to the inadequacies of modern agriculture. Many consumers are familiar with the concept of organic food. Organic production systems are geared toward reducing the presence of synthetic pesticides and fertilizers on land and in the food products. Most organic producers also incorporate conservation practices such as, low or no till, drip or precision irrigation, composting for nutrients, integrated pest management, intercropping, and crop rotation. In addition to sustainable agriculture, agroecology and permaculture have been on the rise, both as practice and social movements.

The principles of agroecology entail much of what is considered to be sustainable agriculture, such as soil and water conservation, but the focus is on a more holistic practice for land management. As the name implies, agroecology treats agricultural land as an ecosystem nested within the regional ecosystem. However, agroecology is also a movement tied to social sustainability concepts, such as food sovereignty, meaning growers should have a say in what they produce and how it is marketed and sold. Permaculture also incorporates sustainable agriculture techniques; however, this practice is geared toward creating a more regenerative system or permanent landscape for food production, such as a food forest (Mollison 1988). Using trees, shrubs, perennials, and locally adapted annual varieties requires less intense crop management. Permaculture does not discourage the production of annual crops; however, it is understood that such systems are inherently destructive.

Perhaps the most well-known and contentious topic in agricultural sustainability is that of genetically modified organisms (GMO or GM). While many focus on health claims around GMOs in food, the most important link to farmers is the loss of power that farmers are faced with when investing in genetically engineered crops. Genetic engineering has resulted in the evolution of patent-protected seeds. Traditionally, farmers saved and shared seeds for future growing seasons by setting aside a portion of their crop (Stein 2005). Today, farmers using GM seeds cannot engage in the long-held practice of seed saving and sharing. GM seeds are often bred to be sterile, but more importantly, farmers found to be saving GM seeds are liable to be sued by the corporations holding the patents (Blakeney 2011). In addition to the exorbitant prices farmers must invest on seeds, many patent-protected seeds come with patent-protected inputs that must be used in conjunction for optimum yields. To add insult to injury, the GMO industry, like that of other inputs, is dominated by just a handful of companies, leaving farmers with limited options (ETC Group 2008; James 2002 cited in Blakeney 2011).

The Disruption to Corporate Food

The US food system today can be depicted as an hourglass figure; at the top are millions of farmers producing agricultural commodities; at the center is a bottleneck composed of a small number of powerful distributors, processors, and retailers, who in turn sell the products to millions of consumers (Carolan 2016) (Fig. 22.1). The bottleneck indicates a consolidation of corporate power that has been deepening through acquisitions and mergers (Howard 2009). Recently scholars have added that the food system hourglass is now hanging

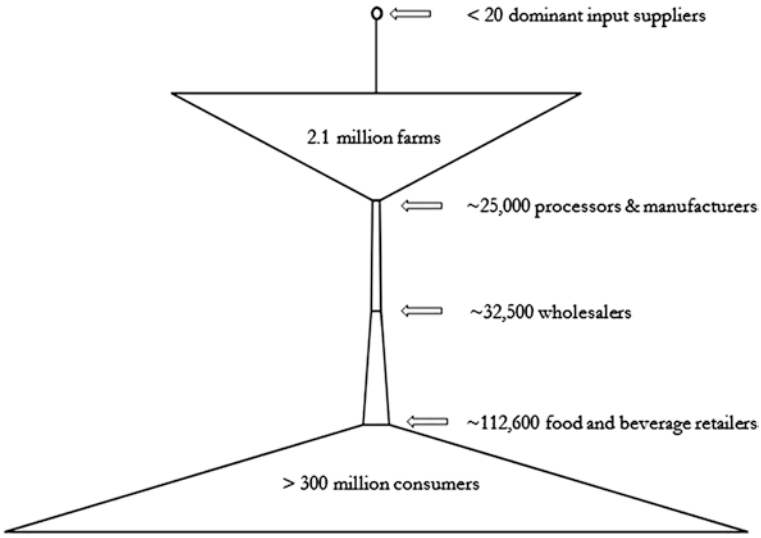


Fig. 22.1 US food system hourglass (Source: US food system hourglass image adapted from Carolan (2016))

by a thread, as the seeds, fertilizers, and pesticides farmers invest in are also controlled by a handful of mega corporations.

In the United States, roughly 50 percent of food retailing is controlled by only five companies, and 82 percent of beef packaging is handled by only four companies (Holt-Giménez 2009; Carolan 2016). This is not a phenomenon unique to the US. Four firms control over half of the world seed market, just four firms handle 99 percent of global chicken breeding, and five companies control all of the GMO market (ETC Group 2008; EcoNexus 2013; James 2002 cited in Blakeney 2011). When evaluating who holds power and who controls the global food system, scholars have argued that we have now entered the corporate food regime (McMichael 2009). The local food movement is one effort seeking to disrupt corporate control of food and re-embed agriculture back in the community.

The rise of local food advocates across the United States has led to the expansion of farms and gardens in urban areas. For centuries, farming has been primarily a rural occupation. As the human population has grown exponentially, migration to urbanized areas has been an increasing trend. More humans live in urban areas than ever before, a trend expected to continue for the next 30 years (United Nations 2014). As more people move into cities and suburbs, the division between food production and consumption will be the greatest it has ever been in human history. Urban agriculture has been theorized as a means to fill this rift (McClintock 2010).

Urban and peri-urban agriculture have been on the rise across the United States for over a decade as a response to shortcomings in the current food system. Residents across the nation have been contesting zoning laws to push the boundaries of where farming can happen. In many cities, residential zoning laws prohibit citizens from engaging in urban agriculture for profit, and in extreme cases, for personal consumption as well (Schindler 2012; Choo 2011). Nevertheless, across the US cities are revamping zoning laws to meet sustainable development goals using urban agriculture (Goldstein et al. 2011).

Urban agriculture takes many forms, such as small-scale farms, rooftop gardens, community gardens, farmers' markets, and community supported agriculture programs. Recently there has been an explosion in Food Policy Councils at regional, state, and local levels seeking to grow the local food movement and build resilient food systems in urban environments (Harper et al. 2009). Increasing urban food spaces has proven to have economic, health, and social benefits (Golden 2013). Many urban farms focus on for-profit food production, but the majority also incorporate social initiatives, such as food security, community building, and education (National Center for Appropriate Technology 2017).

New farmers in urban areas have been trying their hand at agriculture driven by a variety of motives. Many projects seek to increase access to healthy food in the surrounding communities, yet other examples of urban agriculture focus on empowering communities as an act of resistance (White 2011). In Detroit (and many other cities), the urban agriculture movement has been addressing race, gender, and class-based disparities in food access by transforming vacant lots into thriving gardens (Colasanti et al. 2012; White 2011). While many projects seek to empower people, others strive to foster resilience in the local economy. Farming the city takes many forms; nonetheless, when combined with ecologically sound practices, urban agriculture is uniquely suited to address various sustainability goals.

Case Study

The most important intention of Treehugger Organic Farms is growing the freshest, tastiest and healthiest food. We do so by focusing on feeding the soil rather than the plant…Bacterial and fungal activities in the soil feed the plant and help the plant build its immune system by creating an ideal environment for the uptake of minerals and nitrogen. Healthy soil improves disease and pest resistance…proper crop rotation, cover cropping, and planting polyculture guilds are also important practices that ensure a sustainable and rejuvenative farming strategy. We reserve space for native plants that

are home to beneficial insects, in turn they help us create a balanced ecosystem to attain our farming goals while eliminating the need to use chemicals to fight pests and diseases. Effectively, we imitate nature and not try to reinvent it. With a greater understanding of our environment and its inhabitants we keep on progressing in harmony and ever renewed passion for our wonderful and bountiful Mother Earth.

With Love,
Your Treehuggers
(Treehugger Organic Farms Website 2017)

Birth of a Farm

The Greater Miami area is known as the heart of South Florida. It is composed of Florida's top three most populous counties, Miami-Dade, Broward, and West Palm Beach. Broward County has a population of roughly 1.9 million and has the highest population density of all Florida counties (US Census 2016; Rayer and Wang 2014). Broward has a modest agricultural community with less than 500 farms, over 300 of which are under ten acres; in 2002, there were 353 farms operating with annual sales valued under $25,000 and 277 of those farms had sales under $10,000 (NASS 2002). However, the majority of agricultural sales in Broward does not come from food; it comes from nurseries, floriculture, and sod (NASS 2002).

Climatically speaking, South Florida is not a forgiving place for agricultural practice. The Greater Miami area was originally part of the Everglades wetland and is vulnerable to inundation. While many farmers across the United States have to contend with limitations of winter, South Florida farmers struggle against intense heat, in turn relishing "winter" weather for planting crops. Florida farmers must manage highly alkaline soils (resulting from limestone bedrock), year-round heat stress (with temperatures often above 88 °F), flooding from torrential rains in the summer wet season, a host of soil-borne diseases that accompany sub-tropical climates, and the risk of severe storms and hurricanes. Coupled with the pressures of development and a general consumer preference for air-conditioned supermarkets, it is a wonder there are any farmers in South Florida's urban and suburban landscape at all.

In 2012, Nicolas (Nic), a Canadian investor started on a journey that led to the creation of Treehugger Organic Farms in Broward Country, Florida. As a lover of fresh fruits, Nicolas grew disheartened with tasteless, poor quality fruits sold even in the finest markets. Coupled with a concern for the prevalence of toxic chemicals and genetically modified organisms in the food system, he set out to purchase a plot of land on which to grow his own food. Nicolas did not have a background in farming, but he had more than enough

financial capital to invest in land and hire help. He ultimately purchased a 4.6 acre abandoned plantation located in a mixed-use zone in the town of Davie. The neighboring properties on the south were residential, to the west was a coconut and palm plantation, on the northern side was a church, and the eastern border ran along a main street, S. Flamingo Road.

The intention for the land was twofold, it was primarily meant to be a space for the owner to be able to grow fresh fruit without chemicals and free of GMOs. He was in search of quality produce and had been disappointed by supermarket selections one too many times. The second intention was to provide high quality, affordable, local, and organic food to people within the community, "not as a business per se, but to give back to the community." To do this, he would have to find help. In the weeks after purchasing the property, Nic hired labor to clear the land to make way for his new project. Because he had no prior experience growing food, he needed experienced help to develop a plan. Within a few weeks he connected with three young and eager individuals who shared his desire to create an urban, sustainable farm from ground zero. David, Jason, and Santiago were the primary personnel responsible for developing a plan for the property that became Treehugger Organic Farm. All in their mid-20s, these young men were excited to finally have a piece of land on which to create an oasis in the city. Combined, their backgrounds and interests were part permaculture part agroecology, and they were fueled by resistance to the industrialized food system.

David, Jason, and Santiago had been interning at Verde Gardens in Homestead, Florida, when they first met with Nic to discuss the prospect of developing the farm. David was finishing his bachelor's degree in Environmental Studies, and had certificates in both agroecology and permaculture design. His previous experience entailed managing a community garden and working on the 22-acre property at Verde Gardens, a permaculture project growing food in the city for formerly homeless women and children. Jason and Santiago were also heavily involved with the development of Verde Gardens and had taken permaculture design courses. It was agreed that their combined experiences had prepared them to undertake the project, but they could not begin a contract until January 2013.

Breaking Ground

In the months leading up to January, Nic began breaking ground. After clearing the land, he used a top grinder to mulch tree and plant debris that was cleared to be used at a later time. One of the most important aspects of permaculture and agroecology is the development of a closed loop system, where

the waste stream from the farm is used for other projects on farm, such as the production of compost. Next came the construction of a structure that would become both a shed and a home for farm personnel, and a contractor was brought in to wire electricity for the new structure. Late 2012, a pond was excavated to be used to store water for irrigating the land. The investments did not stop there, pumps were purchased for the irrigation system and a truckload of soil was brought in for the garden beds. If you ask Nic how much he spent that first year, he doesn't have a clear answer. Primarily he is thankful he had the capital to make those investments.

In 2013, the Treehugger Organic Farm team hit the ground running. They purchased fruit trees for the orchard and invested in seeds for the garden beds they were building to grow vegetables, herbs, and greens. Nic defaulted to letting David, Jason, and Santiago create a plan for the development of the land. Together they made a list of the resources that would be needed, including things such as common garden tools, pots, wheelbarrows, shade cloths, hoses, irrigation equipment, nozzles, labels, and buckets for compost tea brewing. It also listed the eco-friendly techniques they would use to handle weeds, such as hand pulling, hoeing, and mulching. They drafted the many ways that water would enter and exit the farm, from rain, to the pond, to a well, and strategies for water conservation, such as rainwater harvesting, gray water reuse, and mist irrigation. They drew out a plan for the systems and structures that needed to be built in order to increase sustainability on the farm, including a composting toilet and a shaded nursery built entirely from recycled materials. The creation of a map of all of the zones used in permaculture planning can be found on a YouTube video posted by Jason (https://www.youtube.com/watch?v=ytTL2Gsla7I). The plan for the food forest entailed a sketch of fruit trees and plants that would grow well together. They also developed plans for several banana circles, surrounded by cassava, sweet potatoes, and other species, a common practice in tropical permaculture.

Maintaining ecological integrity was a primary goal for the team. Going through the messages sent to their supporters on their website and through Facebook in 2013, it is easy to recognize their focus on environmental sustainability. There are posts about maintaining a diverse habitat for integrated pest management and gratitude for frogs and small snakes eating pests. There is also a description of the diverse crop species being planted and harvested, ranging from annual crops to perennial crops to fruit trees, including a variety of lettuces, peppers, carrots, and radishes as well as sprouts, turmeric, tulsi, herbs, sweet potatoes, lychee, black sapote, jackfruit, and the list goes on. In true permaculture style, one post reads, "We don't grow food, we grow soil (Facebook post August 28, 2013)." Coupled with the goal of environmental sustainability was the goal to be

socially sustainable as well. This is best noted in their connection to the greater community and ideals of community food security.

By September of the first year, the farm was already well on its way to becoming embedded in the community. The farm had many volunteers who come to engage in hands-on activities, such as building and planting. Several workshops had been hosted on-site, not just by the farm personnel but by the external community as well. Permaculture Miami taught a design course, a professional gave a talk on the practicality of using greywater which was followed by a demonstration installing a greywater system for the farm. There were workshops on plant grafting and making medicinal elderberry syrup, and a documentary screening of *The Future of Food* was hosted by Food and Water Watch. The excitement of having a piece of land on which to create a truly sustainable farm community was beginning to settle in.

In late 2013, the team decided to market Community Supported Agriculture (CSA) shares for the upcoming growing season. A CSA is a way for consumers to pay for a share of weekly produce ahead of the growing season; the consumers invest in the farmers, who in turn secure payment for a portion of their crop. On September 4, 2013, a post on the website read, "CSA is a chance to reclaim our right to healthy food, to use our economic spending power in a way that supports environmentally conscious farms and strengthens local business, to meet the people who grow your food, learn the land where it comes from and build your community. It's a commitment that can change the world." The significance of the post is that it is not just about access to healthy food, rather it encapsulates a message about food politics and power dynamics.

The saying, "you are either born into farming or you marry into it," bears importance for young urbanites who wish to begin farming the city. Like most young urban farmers, David, Jason, and Santiago had never owned land or been given a *carte blanche* on which to create an oasis farm. However, their motivations for developing Treehugger into a model permaculture farm in the city were slightly more complex than Nic's. A few months into 2014, the farm personnel released a few posts stressing the need for political activism. The first was a call to action to show up at city hall to voice opposition at a public hearing on GMO labeling. This was followed weeks later by a highly charged post that read:

> *The GMA [Grocers Manufacturing Association], whose 300-plus members include Monsanto, Coca-Cola, and General Mills, is also pushing a Congressional bill called the "Safe and Accurate Food Labeling Act of 2014." The bill, dubbed the "DARK" (Denying Americans the Right to Know) Act, would actually preempt all states from*

passing GMO labeling laws…The constitution was meant to prevent federal superpowers [from] becoming corrupted, and from creating an authoritarian, fascist federal government. We've watched our individual and state rights deteriorate over many decades, succumbing to these enormous industry powers, and this is probably one of the biggest, most blatant overreaches yet…Protect the freedoms the colonists fought and died for. Make some noise and speak up. Educate as many as possible.

While Nic's initial intention was to grow food for himself and make clean healthy food accessible for the greater community, the personnel were fueled by something greater, opposition to corporate control of the food system. These motivational differences became more prevalent down the road.

Tough Times Ahead

In the second year, the farm continued to expand its presence. Produce was sold at market stands in front of a Whole Foods market in Fort Lauderdale and Pembroke Pines, as well as a farmer's market in Delray Beach. Produce was sold on-site Fridays from 3:00 PM to 6:00 PM, and on Sundays they hosted market fairs on-site, bringing vendors of many trades. Although the farm was producing bananas and other crops, many of the fruit trees would take several years to bear fruit. To supplement income, the team would buy specialty produce from other local growers to resell at the markets. This strategy is actually quite common for small farms across the United States participating in direct sales to consumers. In South Florida, offering up fresh coconut water and tropical fruits at farmers' markets is simply not enough; having specialty products like fresh sugarcane juice, wild jumbo peanuts, and pili nuts attracted a variety of consumers. Even with the modest income made at these venues, Nic had yet to break even.

Though Nic says he never had the intent to run the farm using a business model, he never imagined the setbacks and expenses that came with farming. The CSA model never really took off; he says this was partly due to poor marketing, but also because he believed the farm was not ready to produce enough in the second and third year. There were issues with high soil pH that slowed plant growth. Torrential downpours in 2014 and 2015 flooded the field, washed soil away from the plant beds, and ruined some of the crops. Every year they had to reform the garden beds manually. During a tropical storm, strong winds destroyed some of the most fruitful banana plants and pineapple plants that had yet to bear fruit. The growth of weeds was incessant and because the farm was organic, it took serious manual labor and dedication to

manage. While many know farming is both physically and psychologically challenging, nothing short of experience can prepare someone for the task.

There were also expenses accumulating every year. In the beginning there were five people as contracted labor, and Nic soon realized that was not a possibility. For the two subsequent years Nic kept David, Santiago, and Jason as contracted labor. He had to build a walk-in cooler on-site to maintain the produce fresh. Then came the expense of a walk-behind tractor to make work a little easier. One of the greatest challenges in farming that Nic was unaware of is the disjuncture between seasonal production and sales. Farmers across the world are faced with months in which there is zero income. The seasonality of farming is the reason why so many farm jobs are temporary and filled with migrant laborers. In idle times, most farmers and farm laborers tend to work other jobs.

The Quest for Sustainability

Even with all of these challenges, the team pushed on. The farm continued to reach out into the community and expand their production. They began accepting electronic benefits from the USDA Supplemental Nutrition Assistance Program for low-income families. They connected with Growing Broward, a non-profit food system cooperative, and teamed up with the Autism Society of Broward to get youth ages 13 and up engaged with nature and the farm. Every year they hosted at least one or two "permablitz" to get volunteers to help prepare for the upcoming seasons and even hosted a small summer camp for kids. The food documentaries, workshops, and public farm tours continued. Some of their produce and sprouts were even being used in local restaurants.

In 2015, 100 fruit trees were added to the property including: avocado, barbados cherry, canistel, cherry rio grande, custard apple, coffee, green sapote, jaboticaba, jack fruit, jujube, longan, mamoncillo, mango, rolinia, sapodilla, soursop, and star fruit. Everyone knew it would be several years before most of these would bear fruit for profit. In the meantime, the farmers continued growing seasonal greens and produce, and Nic continued supplementing sales with tropical fruits and nuts from other growers at their stands. Toward the end of 2015, Jason, Santiago, and David expressed excitement that their vision of a sustainable, permaculture farm was becoming clearer, but Nicolas was feeling jaded, physically exhausted, and unhappy with the need to resell food grown by others.

Early in 2016 Nic sat down with the team to discuss the financial struggles. Jason and Santiago made the decision to terminate their contracts and moved

to manage another local farm so that Nic and David could continue the great work that was already underway. That year David and Nic spent almost every day of the week laboring long hours. Because Nic was no longer paying three salaries, the farm was finally making profit and could be considered economically sustainable (by small farm standards). The farm had a profit of roughly $14,000 in 2016. Recall that 277 out of 500 farms in Broward have a net income of less than $10,000. Though the farm was finally on track to be ecologically, socially, and economically sustainable, it came at a cost.

Nic's physical health was deteriorating and his passion for farming had run dry. The need for farmers to self-exploit is often overlooked by those who do not farm. Many small farms rely on the use of family members for labor. As mentioned previously, one of the easiest ways for farmers to cut costs is to reduce the cost of labor, either by paying workers less or letting them go. Though he eventually hired two more temporary workers, Nic only paid himself occasionally. Since the start of the project in 2012, the expenses had exceeded $800,000 (including initial investment in land).

Now that the farm is fully sustainable, Nic's body and heart are no longer up for the project. At the time of the writing of this chapter, Nic decided to sell the property. He claims he was never interested in running his farm using a strict business model, but that doing so might have made things easier in the long run. He firmly believes had he tried to run the farm with a focus on profit, the community aspect would never have developed the way it did. Nic already purchased another property with an established orchard, requiring less work to maintain; the primary goal of this land is to produce fruit for personal consumption. According to Jason, Nic did not share the same vision for a sustainable food system that drives much of his work.

When the news broke in April 2017 that the farm would be closing, community members began to rally together to see how they could help. Though Nic invested substantial financial capital to build a sustainable urban farm, the original personnel have a vested interest in the land that they worked so hard to establish. It was David, Jason, and Santiago that developed the permaculture plan for the land and they poured every ounce of their energy into making it a success. They initiated a campaign to raise money to establish a community land trust to keep the land as a community farm, but were given less than a month to counter the offers developers had already made. Nic recently decided to sell the land to a neighboring farmer (who promised to maintain the farm organic and keep the fruit trees) for significantly less than what developers have offered. As for David, Santiago, and Jason, community food security is still very much a part of their lives, but without land, confronting the task has become a little more complex.

Lessons Learned

Social Sustainability

- A successful farm must be able to positively impact the surrounding community beyond simply the introduction of local, healthy food.
- Treehugger Organic Farms successfully created a space for people to connect with food in the city through outreach, public tours, volunteer opportunities, documentaries, summer camps, and a market fair in an effort to enhance food security, build social capital, and improve local residents' lives.

Ecological Sustainability

- Treehugger Organic Farm was transformed from a derelict plantation into a model organic farm, but it did not happen overnight; it took several years to reach that state.
- The creation of an environmentally sustainable farm requires the integration of concepts from not only sustainable agriculture but also agroecology, treating the land as an ecosystem, and permaculture, instilling a sense of permanence within the landscape.

Economic Sustainability

- Establishing an ecologically and socially sustainable farm (urban or rural) requires significant upfront capital.
- Small-scale agriculture is not a lucrative business, and additional research is needed to develop and document strategies to make it economically sustainable.

Challenges and Barriers

The case study of Treehugger Organic Farms demonstrates the extent to which disparate knowledge bases and visions can lead to a mix of sustainability successes and failures. In 2012, the union between this particular farm owner and personnel seemed perfect. It took several years for the farm to be fully ecologically, socially, and economically sustainable. This lag (which Nic was not

expecting) was foreseen by the personnel who know just how challenging farming can be. Nic lacked knowledge of the level of exploitation that most small farmers engage in to see their projects to fruition, whereas, Jason, Santiago, and David would not characterize the long days of hard work as exploitation, rather a labor of love.

If sustainable urban farms are to continue to grow in numbers (not just size), agricultural projects need to be prioritized over urban sprawl. Cities seeking to grow their sustainable initiatives should prioritize urban agriculture, not just by revamping zoning laws but also by offering financial help to beginning farmers. As urbanization and corporate control of food increases, people living in cities will become more distant from food production, and disparities in food access will rise. The capacity for small urban farms to compete with industrial farms is small, but the positive impacts they have on the economy, environment, and surrounding community are too great to pass up.

Acknowledgments The data for this case study was collected through interviews and email communication with the owner and staff, April through May 2017. Additional information was collected using content analysis of the Treehugger Organic Farms website and Facebook page.

http://www.treehuggerorganicfarms.com/
https://www.facebook.com/TreeHuggerFarms/

Further Reading

Altieri, Miguel A. 1999. The Ecological Role of Biodiversity in Agroecosystems. *Agriculture, Ecosystems and Environment* 74: 19–31.

Blakeney, Michael. 2011. Recent Developments in Intellectual Property and Power in the Private Sector Related to Food and Agriculture. *Food Policy* 36: 109–113.

Carolan, Michael. 2016. *The Sociology of Food and Agriculture*. 2nd ed. New York: Routledge.

Carson, Rachel. 1962. *Silent Spring*. Boston: Houghton Mifflin Company.

Choo, Kristin. 2011. Plowing Over: Can Urban Farming Save Detroit and Other Declining Cities? Will the Law Allow It. *American Bar Association Journal* 97: 43–70.

Colasanti, Kathryn J.A., Michael W. Hamm, and Charlotte M. Litjens. 2012. The City as an 'Agricultural Powerhouse'? Perspectives on Expanding Urban Agriculture from Detroit, Michigan. *Urban Geography* 33 (3): 348–369.

EcoNexus. 2013. *Agropoly – A Handful of Corporations Control World Food Production*. http://www.econexus.info/sites/econexus/files/Agropoly_Econexus_Berne Declaration_wide-format.pdf. Accessed 28 Apr 2017.

ETC Group. 2008. *Who Owns Nature? Corporate Power and the Final Frontier in the Commodification of Life*. http://www.etcgroup.org/content/who-owns-nature. Accessed 28 Apr 2017.

Eubanks, William S. 2009. A Rotten System: Subsidizing Environmental Degradation and Poor Public Health Wins Our Nation's Tax Dollars. *Stanford Environmental Law Journal* 28: 213.

Figuerola, Eva L.M., et al. 2015. Crop Monoculture Rather than Agriculture Reduces the Spatial Turnover of Soil Bacterial Communities at a Regional Scale. *Environmental Microbiology* 17: 678–688.

Garcia, Deborah K. 2004. *The Future of Food*. http://www.thefutureoffood.com/. Accessed 14 May 2017.

Gliessman, Stephen R. 1992. Agroecology in the Tropics: Achieving a Balance Between Land Use and Preservation. *Environmental Management* 16 (6): 681–689.

Gliessman, Stephen R., Eric Engles, and Robin Krieger. 1998. *Agroecology: Ecological Processes in Sustainable Agriculture*. Boca Raton: CRC Press.

Golden, Sheila. 2013. *Urban Agriculture Impacts: Social, Health, and Economic: A Literature Review*. http://asi.ucdavis.edu/programs/sarep/publications/food-and-society/ualitreview-2013.pdf/view. Accessed 2 May 2017.

Goldstein, Mindy, et al. 2011. Urban Agriculture: A Sixteen City Survey of Urban Agriculture Practices Across the Country. *Turner Environmental Law Clinic.* http://www.jhsph.edu/research/centers-and-institutes/johns-hopkins-center-for-a-livable-future/_pdf/projects/fpn/urban_community_planning/urban_agriculture_a_sixteencity_survey_of_urban_agriculture_practices_across_the_country.pdf. Accessed 3 May 2017.

Guthman, Julie. 2014. *Agrarian Dreams: The Paradox of Organic Farming in California*. Oakland: University of California Press.

Harper, Alethea., Annie Shattuck., Eric Holt-Giménez., Alison Alkon and Frances Lambrick. 2009. Food Policy Councils: Lessons Learned. Food First Institute for Food and Development Policy. https://foodfirst.org/wpcontent/uploads/2014/01/DR21-Food-Policy-Councils-Lessons-Learned-.pdf.

Henry, Mickael, et al. 2012. A Common Pesticide Decreases Foraging Success and Survival in Honey Bees. *Science* 336: 348–350.

Hinrichs, C. Clare, and Thomas A. Lyson, eds. 2007. *Remaking the North American Food System: Strategies for Sustainability*. Lincoln: University of Nebraska Press.

Holt-Giménez, Eric. 2009. From Food Crisis to Food Sovereignty: The Challenge of Social Movements. *Monthly Review* 61 (3): 142–156.

Howard, Philip H. 2009. Visualizing Consolidation in the Global Seed Industry: 1996–2008. *Sustainability* 1 (4): 1266–1287.

Jacques, Peter J., and Jessica Racine Jacques. 2012. Monocropping Cultures into Ruin: The Loss of Food Varieties and Cultural Diversity. *Sustainability* 4 (11): 2970–2997.

Jetoo, Savitri, Velma Groover, and Gail Krantzberg. 2015. The Toledo Drinking Water Advisory: Suggested Application of the Water Safety Planning Approach. *Sustainability* 7 (8): 9787–9808.

Lewontin, R.C. 1998. The Maturing of Capitalist Agriculture: Farmer as Proletarian. *Monthly Review: An Independent Socialist Magazine* 50 (3): 72.

Liebman, Matt, and Elizabeth Dyck. 1993. Crop Rotation and Intercropping Strategies for Weed Management. *Ecological Applications* 3 (1): 92–122.

Lobao, Linda, and Katherine Meyer. 2001. The Great Agricultural Transition: Crisis, Change, and Social Consequences of Twentieth Century US Farming. *Annual Review of Sociology* 27: 103–124.

McClintock, Nathan. 2010. Why Farm the City? Theorizing Urban Agriculture Through a Lens of Metabolic Rift. *Cambridge Journal of Regions, Economy and Society* 3 (2): 191–207.

McMichael, Philip. 2009. A Food Regime Genealogy. *The Journal of Peasant Studies* 36 (1): 139–169.

Michalak, Anna M., et al. 2013. Record-setting Algal Bloom in Lake Erie Caused by Agricultural and Meteorological Trends Consistent with Expected Future Conditions. *Proceedings of the National Academy of Sciences* 110 (16): 6448–6452.

Mills, Paul K., and Purvi Shah. 2014. Cancer Incidence in California Farm Workers, 1988–2010. *American Journal of Industrial Medicine* 57 (7): 737–747.

Mollsion, Bill. 1988. *Permaculture: A Designer's Manual*. Tyalgum: Tagari Publications.

NASS (National Agricultural Statistics Service). 2002. *2002 Census of Agriculture County Profile: Broward, Florida*. https://www.agcensus.usda.gov/Publications/2002/County_Profiles/Florida/. Accessed 10 May 2017.

National Center for Appropriate Technology. 2017. A National Sustainable Agriculture Assistance Program. *Urban Agriculture*. Retrieved 12 May 2017.

National Cancer Institute. 2011. *Agricultural Health Study*. https://www.cancer.gov/about-cancer/causes-prevention/risk/ahs-fact-sheet. Accessed 3 May 2017.

Ollerton, Jeff, et al. 2014. Extinctions of Aculeate Pollinators in Britain and the Role of Large-Scale Agricultural Changes. *Nature* 346: 1360–1362.

Pettis, Jeffrey S., et al. 2013. Crop Pollination Exposes Honey Bees to Pesticides Which Alters Their Susceptibility to the Gut Pathogen *Nosema ceranae*. *PLoS ONE* 8 (7): e70182.

Postma, Johannes A., and Jonathan P. Lynch. 2012. Complementarity in Root Architecture for Nutrient Uptake in Ancient Maize/Bean and Maize/Bean/Squash Polycultures. *Annals of Botany* 110 (2): 521–534.

Rayer, Stefan, and Ying Wang. 2014. *Measuring Population Density for Counties in Florida*. https://www.bebr.ufl.edu/population/website-article/measuring-population-density-counties-florida. Accessed 10 May 2017.

Reeves, D.W. 1997. The Role of Soil Organic Matter in Maintaining Soil Quality in Continuous Cropping Systems. *Soil & Tillage Research* 43: 131–167.

Rosset, Peter. 2006. *Food Is Different: Why We Must Get the WTO Out of Agriculture*. New York: Zed Books.

Schindler, Sarah. 2012. Of Backyard Chickens and Front Yard Gardens: The Conflict Between Local Governments and Locavores. *Tulane Law Review* 87 (231): 1–73.

Stein, Haley. 2005. Intellectual Property and Genetically Modified Seeds: The United States, Trade, and the Developing World. *Northwestern Journal of Technology and Intellectual Property* 3 (2): 160–178.

Tilman, D. 1998. The Greening of the Green Revolution. *Nature* 396: 211–212.

Tsubo, M., et al. 2003. Productivity of Maize–Bean Intercropping in a Semi-Arid Region of South Africa. *Water Sustainable Agriculture* 29 (4): 381–388.

United Nations. 2014. *World Urbanization Prospects: Revision. Final Report 2004*. https://esa.un.org/unpd/wup/. Accessed 20 Apr 2017.

University of California, Berkeley. 2017. *Monoculture and the Irish Potato Famine: Cases of Missing Genetic Variation*. http://evolution.berkeley.edu/evolibrary/ article/agriculture_02. Accessed 20 Apr 2017.

US Census. 2016. *QuickFacts*. Broward County. https://www.census.gov/quickfacts/table/PST045216/12011,00. Accessed 14 May 2017.

USDA-ERS (United States Department of Agriculture – Economic Research Service). 2016a. *The Number of Farms Has Leveled Off at About 2.1 Million*. https://www.ers.usda.gov/data-products/chart-gallery/gallery/chart-detail/?chartId=58268. Accessed 3 May 2017.

———. 2016b. *America's Diverse Family Farms*. https://www.ers.usda.gov/publications/pub-details/?pubid=81401. Accessed 3 May 2017.

Wang, Zhi-Gang, et al. 2014. Intercropping Enhances Productivity and Maintains the Most Soil Fertility Properties Relative to Sole Cropping. *PLoS ONE* 9 (12): e113984.

White, Monica M. 2011. Sisters of the Soil: Urban Gardening as Resistance in Detroit. *Race/Ethnicity: Multicultural Global Contexts* 5 (1): 13–28.

Wines, Michael. 2014. Behind Toledo's Water Crisis, a Long-Troubled Lake Erie. *The New York Times*, August 4. https://www.nytimes.com/2014/08/05/us/lifting-ban-toledo-says-its-water-is-safe-to-drink-again.html. Accessed 5 May 2017.

Part III

Economy

Industrial and post-industrial economies have proven to be harmful to the environment and to the broader sustainability of our planet. Yet, this economic activity drives much of what we do in our modern era. Can we continue to have economic growth while we advance a sustainability agenda? Are there ways we can transform our economies into ones that are gentler on the planet and on society? The following 11 chapters delve into these issues. From fashion to tourism, there are efforts underway to improve the transactional world.

What is striking about this group of chapters is that they all demonstrate that there is tremendous power for good in the organizations they describe. Each chapter notes that there are change agents at work that are striving to limit the impact of their activities on the planet. Some have had great success in transforming one organization and others have had even more success in transforming whole economic sectors.

In some situations, businesses have been accused of greenwashing their sustainability initiatives to promote their product as earth friendly. However, most now benchmark their initiatives to ensure that there are real outcomes from their work.

23

Economic Development and Sustainability: A Case Study from Long Island, New York

Robert Brinkmann

Background

Economic development focuses on intentional economic growth for the betterment of economic and social conditions (Todaro and Smith 2014). While there are distinctly national economic development schemes that have been put in place, such as the Marshall Plan after World War II (Jones 2017), most economic development strategies take a regional or metropolitan focus such as the Tennessee Valley Authority's economic development strategy in rural America during the depression (Downs 2014). Taking on many different forms and processes, economic development does not have a distinct structure or definition (Giugale 2014). It evolved organically with modern capitalism as an important process that links private businesses with governments and non-profit organizations to promote regional or local development and social goals.

Economic Development Organizations

Most economic development organizations in the United States include a mix of public and private stakeholders and focus on a particular region or theme. For example, at the national scale, the Department of Commerce, a Cabinet-level office within the executive branch of the US government, focuses on

R. Brinkmann (✉)
Hofstra University, Hempstead, NY, USA

R. Brinkmann, S. J. Garren (eds.), *The Palgrave Handbook of Sustainability*,
https://doi.org/10.1007/978-3-319-71389-2_23

national-scale economic development (Jorgenson et al. 1987). Below this, each state has some type of economic development organization that promotes business growth within its borders (Reese 2013). Below this are local economic development organizations that focus on urban, suburban, or rural economic development depending on their region (Opp and Saunders 2013). Each of these organizations is often supported by taxpayer dollars and sometimes other private sources of funds (Greenwood and Holt 2015). They are often organized within committees or councils that are appointed by a political leader such as a governor or mayor (Chen et al. 2015). The membership in these committees usually consists of elected officials, business leaders, labor and non-profit leaders, and technical experts. Often the appointment to serve on these committees is limited to a period of time to allow broad participation from community stakeholders. Because these organizations are often taxpayer supported, the efforts of these committees are subject to public oversight and review and their meetings are public.

There are also industry-specific economic development organizations that focus on a specific product. A good example is the California Association of Wine Grape Growers (Szolnoki 2013). These types of organizations do not have economic development as the main goal of the organization, but as part of it. They often do not have the broad set of tools as taxpayer-supported economic development organizations. However, because they work to promote one specific issue, they often interact with taxpayer-supported economic development councils as described in the previous paragraph. Sometimes these types of organizations come into conflict with taxpayer-supported organizations. For example, a paper-manufacturing group may be promoting more industrial development of a river, while at the same time a regional economic development group may be promoting environmental preservation of the same space.

Economic Development Tools

Even though there are many economic development strategies that are used on a regular basis by the committees appointed by public officials, they all involve some type of public investment in public or private endeavors in support of economic development. The main tools involved include:

(1) *Tax breaks*. When a community wants to promote a particular industry, it will give that industry tax breaks to promote investment (Patrick 2014). For example, if a city wants to attract a high-tech industry, it can give it a

tax break for a certain number of years. Often these breaks are given within specific regions or enterprise zones in order to promote cluster development of a particular industry (Mayer et al. 2017).

(2) *Land*. Sometimes land is given away or sold for a reduced price to an organization to attract it to a community (van der Krabben and Jacobs 2012). A good example is community development of industrial parks using public dollars, and very reasonable leases are provided to grow industry and jobs in the community (Cobb 1993).

(3) *Direct investment*. Some industries, particularly expensive start-ups, need funds for equipment or machinery. Some governmental economic development agencies will provide funds or low-cost loans for equipment that promote a particular industry or industries that will hire many people (Román et al. 2013).

(4) *Laws and zoning*. Some industries need help with changing laws and zoning to promote their industry. For example, perhaps an industry needs a zoning variance to build a tall building or a law changed to allow large trucks on the roads. Economic development councils often will work with local, state, or national governments to assist private organizations with these rule changes if it aligns with the organization's development strategies (Zhang et al. 2017).

(5) *Technical assistance*. Sometimes economic development organizations provide technical assistance to groups seeking assistance in getting grants or in providing access to other sources of revenue or assistance (Green and Haines 2011). For example, by interacting with an economic development group, a farmer that produces a particular crop, say a unique mushroom, can learn about other grants from other organizations and can link with other organizations, such as tourism agencies that can assist in promoting mushroom farming. In addition, economic development councils create and manage tremendous amounts of economic information about a region. They have statistics about issues like job growth or decline, education, tax bases, major labor statistics, and educational attainment.

(6) *Infrastructure development*. Sometimes basic infrastructure limits economic development (Ng et al. 2017). It may be a local sewer line or it may be a national rail or port system. No matter the scale, businesses often work with economic development organizations to promote specific types of infrastructure projects.

(7) *Education*. Sometimes the limit to economic growth is the quality and type of public education (Hanushek and Woessmann 2015). Thus, economic development initiatives often are aware of the key gaps in education in the region and communicate this information to public education

experts. It is important to note that economic development education initiatives include not only college education but also education in the trade fields.

(8) *Political access*. Economic development organizations are often the links between individuals seeking to promote the development of their business and the political world. Elected officials are keenly interested in economic development in their districts since their approval ratings are somewhat dependent on a strong economy. They often attend or have representatives attend meetings of economic development committees to become aware of the issues that are raised in the meetings. Via this process, local business leaders can gain access to political leaders to promote their agendas.

Measuring Economic Development

Economic development is measured using standard economic indicators such as jobs created by investment dollars, unemployment, educational attainment, and others (Epstein and Buhovac 2014). Job creation, particularly well-paid job creation, is often used as one of the most significant indicators because due to a standard economic multiplier effect (Moretti and Thulin 2013), one high-paying job can create two to five other jobs in a region. For this reason, local economic development often focuses on trying to attract economic activities that promote high-paying jobs.

Economic development committees and organizations often create their own benchmarks within their planning documents separate from standard economic indicators. For example, a region may be interested in developing a business park on public lands. The number of new companies in the business park may be an indicator that the organization uses to assess success. Often the benchmarks developed in local or regional plans take into consideration the local setting so that indicators are realistic. For example, it would be difficult to have a goal of attracting a high-tech industry in a region with poorly funded and struggling public universities.

Critiques of Economic Development

For the purposes of this chapter, there are two main critiques of economic development that are important to highlight: the fallacy of unending growth and opportunities for corruption. These critiques provide a context for the

emergence of sustainability as an important theme in many economic development initiatives. While each of these is not absent when sustainability becomes ingrained in economic development decisions, their impacts can be lessened.

The first critique, the fallacy of unending growth, calls into question whether or not a region can or should stop growing (Schumacher 1973). Many boosters of growth in local or regional settings have harmed their own communities by advancing too much development or inappropriate growth in a region. Some believe that regions cannot have too much growth. Of course, this is not true. We can have too much growth or the wrong kind of growth. There are many examples where local communities have lured industries to their communities with tax incentives only to find themselves with long-term environmental challenges and infrastructure needs that are unfunded (Williams and Redmond 2014). Plus, growth by community boosters that is not appropriate for the region can be problematic for other community assets. A good example comes from Florida where many boosters have sought to develop offshore oil resources. The state has wisely banned these activities since the development of oil offshore would harm the state's significant tourism industry. While some may want to grow petroleum production as an economic activity in the state, others believe that development of this industry would harm the state's economy. Every region has an economic development gone wrong horror story. That is why it is important to balance economic growth with other regional priorities.

The second critique, opportunities for corruption, highlights a long-standing problem with government and economic development committees and councils. Often these organizations understand how to gain access to public dollars for investment. If you are not one of those directly involved with economic development, you may not know how to participate in government-funded activities. Most economic development committees are public entities and have public meetings. Only if one attends these meetings or gains access to information on the Internet does one fully understand the opportunities available to the public. This has led to some problems with corruption or apparent corruption in some economic development initiatives. We have all heard of politicians who enter office making a small amount of money but leave office wealthy. This happens, in part, because they understand how to invest in emerging economic initiatives.

However, growing concern about corruption associated with governments and economic development has caused greater light to be shed on the activities of economic development organizations (Graeff and Svendsen 2012). The recent document dump of the so-called Panama Papers revealed widespread

corruption of public officials in a number of countries (Obermayer and Obermaier 2017). While these papers highlighted national corruption, most regions of the world have many examples in recent decades of corruption associated with public dollars. Many emerging tools, including sunshine laws that require public disclosure, are seeking to put an end to corruption. While corruption is not a problem in all areas, the bad actors associated with economic development can harm long-term economic development of a region.

Sustainability and Economic Development

Sustainability, which is often defined broadly at limiting our actions on the planet to ensure it long-term health and survivability, has emerged as a key initiative in economic development strategies (Epstein and Buhovac 2014). Communities have come to understand that poor economic development decisions can harm their region's sustainability and that good decisions can enhance it. Sustainability is one of those terms that often is difficult to define in practice since the meaning can be interpreted in so many different ways. However, key themes of sustainability in the context of economic development include, but are not limited to, issues of public lands, water, energy, agriculture, food, transportation, building, land use, environmental justice, brownfields, pollution, and ecosystems (Brinkmann 2016).

When infusion of sustainability is brought within an economic development process, three main changes occur. First, planning committees often question whether or not a particular economic activity is good for the region. They may reject projects that are polluting or that have a large footprint or impact on the area. Second, goals are set that improve the environmental sustainability of a region. Committees and councils may set goals to improve water quality, to reduce greenhouse gas emissions, or to advance organic agriculture. Finally, economic organizations that embrace sustainability can change the business culture in the region. By elevating sustainability as a strategy, the organizations influence a myriad of other microdecisions in other organizations within the region. The combined effect of these three changes significantly impacts a region's economy in ways that promote sustainability and that improves the region in unexpected ways.

Sustainability within a business context has expanded significantly in recent years. Most Fortune 500 do some type of sustainability planning and documentation (Cohen and Muñoz 2017). There are many benchmarking tools that organizations can use to assess their efforts. Even the International Organization for Standardization has developed sustainability benchmarking

that includes issues of business ethics and responsibility (Barnett et al. 2015). Because sustainability has infused so many business practices, it is becoming normal for sustainability to be part of economic development initiatives.

Case Study: Sustainability Within the Context of the Long Island Economic Development Council

During the economic Great Recession from 2007 to 2009, many regional economies throughout the United States suffered (Ross et al. 2014). While a great deal of attention has been given to national and international efforts to bolster the US economy, limited notice has been given to regional approaches to improve local economies. New York's Governor Andrew Cuomo established in 2011 ten regional economic development councils (Fig. 23.1) to try to jump-start local economies at the close of the Great Recession. Many areas of the state were deeply hurt in the years just prior to the announcement, and

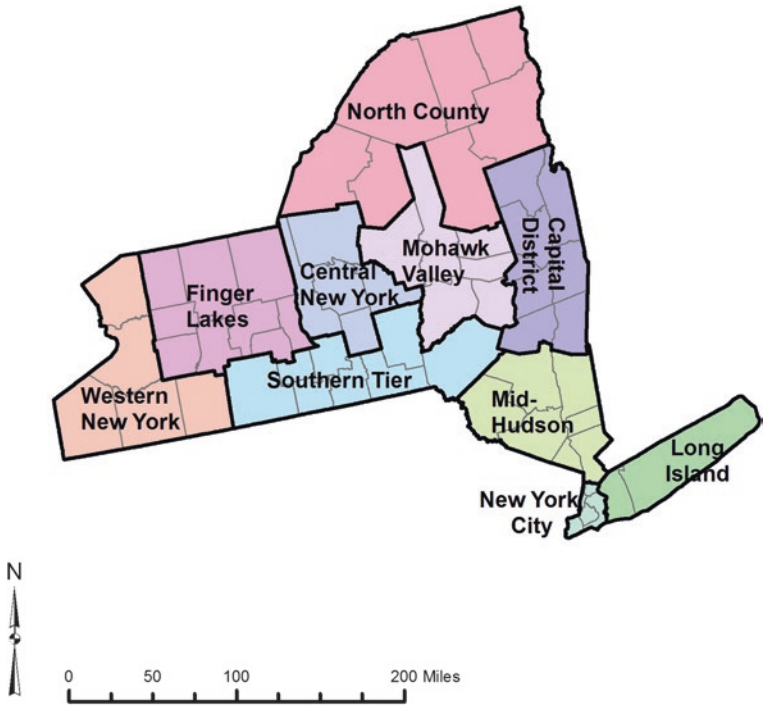


Fig. 23.1 New York State Regional Development Council

many others, particularly upstate regions, never fully recovered to rust belt/Sunbelt migratory changes.

The ten regions were: New York City, Long Island, Mid-Hudson, Capital Region, North Country, Mohawk Valley, Central New York, Finger Lakes, Western New York, and the Southern Tier (Fig. 23.1). Each region is rather different from each other in history, geography, and economic activity. All ten were charged by the governor to develop economic development councils made up of stakeholders consisting of local experts, business, academia, local government officials, and representatives of non-governmental organization. The role of the councils is to encourage economic development within the region by developing state funding priorities that would advance job growth.

While each region had distinctive economic issues, the Long Island region is perhaps the most complex of the ten. In many ways, Long Island has a distinct character. It is first and foremost an island with connectivity challenges (all roads lead through New York City), tourism, fisheries, and coastal hazards. It has post-industrial challenges in that it was once the center of aerospace engineering and manufacturing. It is the home of America's first post-World War II suburbs and has distinct problems with segregation, gentrification, and suburban redevelopment. Plus, vast areas of the eastern end of the island are the home of rich farmland where vineyards and truck farming compete for space with vacation homes of the rich and famous (Euler 2016). Although steeped in Colonial history and the Gatsby Gold Coast mythology, the area now is connected to both New York City and New England in complex cultural and economic links. Nassau County, the westernmost and smallest county of the two that make up the non-New York City part of Long Island, is the most densely populated, while Suffolk County, the large easternmost part of the island, is a more agricultural region (Fig. 23.2).

When the governor established the councils, he asked each one to create a strategic plan that developed initiatives for job creation. Originally, the four main areas on which the Long Island Economic Development Council (Council) focused were: (1) the development of innovation and industry clusters, (2) improvement of infrastructure, (3) enhancement of natural assets and tourism, and (4) workforce development and education. While some of these priorities overlap in some instances and while new priorities such as history and downtown redevelopment emerged later in the process, these four themes remain the focal point of economic development initiatives since the inception of the process (Long Island Regional Economic Development Council 2011, 2012, 2013, 2014, 2015, 2016).

Clearly, enhancement of natural assets and tourism are the main areas that addressed sustainability issues. Some other areas, such as improvement of

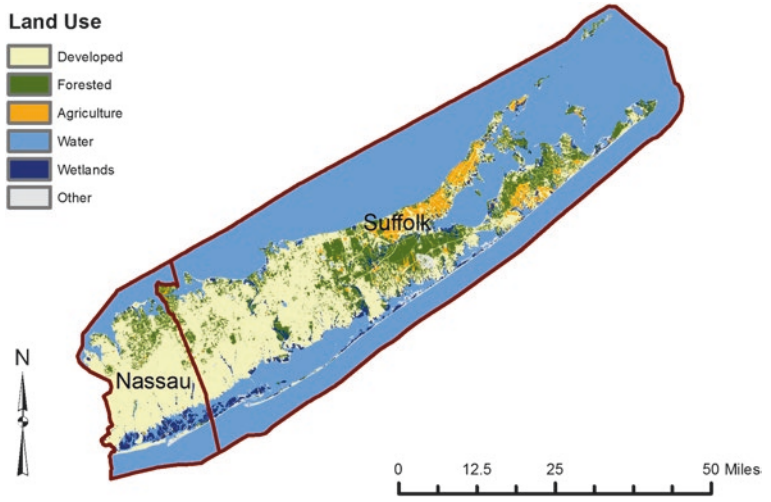


Fig. 23.2 Long Island geography

infrastructure (particularly enhancement of poor sewage treatment plants and removal of old cesspool and septic systems), also encouraged regional sustainability initiatives. The Council used several reports for guidance as they developed projects for funding. Perhaps the most important of these was the Long Island 2035 Plan that focused heavily on sustainability (Long Island Regional Planning Council 2010). Infused within this 25-year plan written in 2010 are a number of environmental and sustainability initiatives particularly promoting sustainable transportation, improving environment conditions through better infrastructure, protecting open spaces and farms, and promoting equity. While the plan provides a very suitable overview of the challenges and goals, there are few measurable outcomes. However, the Council also used the 2013 Cleaner Greener Long Island Regional Sustainability Plan (Cleaner Greener Consortium of Long Island 2013) as guidance. This plan is distinctly different from the 25-year plan in that it provides many clear measurable outcomes that can be used to assess the overall success of sustainability initiatives on Long Island.

The projects that were submitted to the Council for consideration in the area of natural assets and sustainability largely fell into one of the three categories: enhancement of agricultural enterprises, improvement of fishing and shellfishing industries, and protection of natural resources by either preserving land or by enhancing infrastructure. Each one of these will be discussed.

Enhancement of Agricultural Enterprises

Long Island has very specialized truck farming and vineyards that are often part of a broader agritourism culture. Located largely on the less densely populated east end of Long Island, agriculture takes place on relatively small parcels of land. Farmers compete for space with suburban developments and high-end vacation estates of some of the wealthiest people in the world in places like the Hamptons. The days of traditional family farms is past in the region. Now farms often have extensive farm stands, places for bus parking, and wine tasting in order to make ends meet.

One of the more interesting projects that was funded by the Council was a "Grown on Long Island" program that helped to identify produce in grocery stores and farmers markets that was grown on Long Island. Taking advantage of the eat local movement, that has become popular in recent years, the program allowed local consumers on Long Island and the greater New York metropolitan region to buy from local farms. The Grow Local program helped farmers get their produce to local markets without having to reach to a broader national market. It is very difficult to move produce off Long Island due to transportation limitations and a lack of agricultural processing facilities. The Grown on Long Island program created new local markets that expanded opportunities for small farmers.

Improvement of Fishing and Shellfishing Industries

Long Island is famous for its seafood and has been for some time. It has always been widely known for clam, oyster, and scallop production. Today, a fleet of fishing boats operate in Long Island Sound and the Atlantic for commercial open water fishing. One of the challenges in the region has been the decline in water quality for both shellfishing and open water fishing. Some shellfish beds are now off limits due to environmental considerations, and commercial fishing interests are deeply concerned over the move toward offshore wind production in the northeast. Commercial shellfish and open water operators are also worried about changing water conditions as a result of global climate change.

A number of projects were funded to support fishing interests in the region. One project developed by Cornell Cooperative Extension is seeking to bring back the bay scallop industry to Peconic Bay, the extensive bay between the north and south forks of extreme eastern Long Island. In the late 1980s, a brown tide wiped out the thriving scallop industry and it never recovered.

Since then, the bay has improved substantially. Yet the scallop industry has not returned to the production of the past. Researchers at the Cornell Cooperative Extension have worked hard to try to bring the scallops back through an aggressive seeding program. In addition, they trained individuals to develop scalloping operations. With all of this effort, the scallops slowly returned. Through the funding efforts of the Council, the seeding operations increased significantly and several new jobs were created.

Protection of Natural and Cultural Resources

Long Island is the originator of suburban sprawl. America's first modern suburb was built in Levittown a few miles east of Queens in Nassau County in the late 1940s and the 1950s. Since then, many small villages in Nassau County became connected by development. The sprawl has extended into rural areas of Suffolk County in the last few decades. While there are local, state, and national preserves and parks, open land is continuously under threat. In addition, many historic buildings are lost each year as older communities undergo redevelopment, decline, or gentrification. Many would not recognize the rural landscape of Long Island as the home to prehistoric Native American towns, Colonial Villages, or Revolutionary War conflict. Today, the landscape is like many suburban landscapes in the United States. The Council has supported many preservation efforts and park improvements.

While many of the preservation efforts try to reduce sprawl, the council has funded many projects to protect the region's natural resources, particularly Long Island's abundant groundwater and shores, which are threatened by extensive pollution. Much of the pollution comes from sewage treatment plants that utilize old technology and from leaking septic tanks and cesspools. Nitrogen and phosphorus pollution are particular problems that cause algae blooms at beaches and surface water bodies throughout Long Island.

One project that was supported by the Long Island Regional Economic Council is the digester upgrade for a sewage treatment plant operated by the Great Neck Pollution Control District. The district, the oldest one in the region, is trying to reduce nutrient pollution that enters Manhasset Bay, part of Long Island Sound. One of their projects harnesses methane from the digestion of grease and sludge. However, they were at capacity. Funding from the economic development process allowed the district to expand capacity and reduce pollution while producing a usable energy source.

Lessons Learned

Economic development is obviously focused on improving and enhancing a region's economy and does not always bring in sustainability and a key theme. However, in the Long Island situation, earlier and contemporaneous planning processes infused sustainability within the culture of the island. Because sustainability was front and center in the Long Island 2035 Plan and because the region developed a sustainability plan, it made sense for sustainability to inform the development of a regional economic plan. In addition, the region has distinct sustainability issues that are front and center for most people: water pollution, overdevelopment, air pollution, noise, environmental justice, and many other environmental concerns.

Some may argue that some of the sustainability goals in the documents, particularly the Cleaner Greener Long Island Sustainability Plan, are limited and do not take a comprehensive approach to sustainability as other regional plans. For example, many of the energy goals are modest and some of the issues associated with environmental equity on the island are not fully captured. Yet, Long Island is one of the few suburban areas in the United States to develop plans fully focused as sustainability. So, while there are areas to critique, the plans do provide a starting point for infusing sustainability within other planning initiatives. That is exactly what happened with the Governor's economic development process on Long Island. Because sustainability was already part of the lexicon for planning, business, and government stakeholders, it was easy to infuse sustainability initiatives and targets within the economic development process.

Of course, sustainability is all about measuring outcomes and it is difficult to quantitatively assess how all of the projects that were developed since 2011 impacted the sustainability of Long Island. Because economic development is all about creating jobs and enhancing economic development, the outcome measurements do not coincide with the outcomes one would measure in sustainability assessments. As a result, we have very specific numbers of jobs that are available in different sectors, but we do not know how much water quality has improved, how much land was preserved, how fisheries have improved, or other measures of environmental and sustainability success. Certainly, many of the projects that were funded improved key areas of Long Island's sustainability, but we are unable to create an assessment using economic development metrics.

But it should also be pointed out that sustainability was not the only factor that drove the investment decisions of the Council. Some projects were funded that had negative impacts on the environment by putting stresses on

resources such as water, air, land, or culture. These stresses, such as pollution or loss of open land, were not measured. Thus, while sustainability was enhanced through some projects, it is unknown if the positive effects were counterbalanced by the negative effects of others. Certainly, having sustainability front and center in the process made the approval process of environmentally damaging projects difficult. As a result, the net overall effect of infusing the environment and sustainability within the process has largely been seen as a positive outcome throughout the region.

Future economic development initiatives should consider including some types of sustainability outcomes assessment in order to evaluate whether or not funded projects were successful from an environmental perspective. It would be easy to greenwash an economic development process without the ability to quantify the impacts of investment.

Another important lesson within the context of Long Island is that sustainability can be used as an effective tool within a suburban environment. Many who work in planning note that there are many challenges toward suburban sustainability. Most residents are focused on maintaining low taxes and high property values, while also having access to high-paying jobs. Sustainability often ranks low on suburbanite's areas of concern. However, based on the success of the Long Island experience, it is evident that suburban stakeholders understand the need to preserve natural resources and protect the environment. They embrace sustainability as a tool of economic development. The success of the Long Island experience should be a positive omen for those seeking to advance sustainability in similar settings.

Yet, it must be stressed that failure to set the stage for sustainability could lead to bad economic development decisions. A good example of this issue comes from the United States. For years while many countries around the world were developing sustainability plans as part of either the Millennium Development Goals or Sustainable Development Goals processes developed by the United Nations, the United States avoided national comprehensive sustainability planning. While some areas received attention, such as the well-regarded Energy Star® system, little attention was given to comprehensive national planning.

Even without planning, the country moved forward to develop greener energy sources and move away from dirty power plants and energy sources. Of course, this led to the closure and downsizing of some coal mines which led to general economic decline in areas of the Appalachian coal belt. In the 2016 national election, the candidates of the two parties debated the economic development vision of the region. On the Democratic side, Hillary Clinton argued for diversifying the economy of the region and on-the-job

training similar to what she fostered in upstate New York when she was a senator. In contrast, the Republican candidate, Donald Trump, argued that coal should be revived and that the country did not need to worry about greenhouse gas pollution. Because Donald Trump won, in part because of the support of voters in coal country who were worried about their future, there is a strong likelihood that coal will be buoyed up by new government policies. Because the nation does not have sound sustainability planning, the stage is set for a return of non-sustainable practices through the redevelopment of the coal industry.

While the national example may seem extreme, there are many local examples where local governments make bad sustainability decisions in the name of economic development. That is why it is crucial to have sustainability as part of any local or regional planning process prior to the advent of economic development planning.

Challenges and Barriers

One of the most profound challenges to infusing sustainability within any economic development process is broad acceptance for sustainability among stakeholders. That is why it is important to bring sustainability front and center in all local and regional decision-making processes. The environmental activist community is often in an opposition position in local decision-making. However, by finding common ground, environmentalists can help to transform how the community sees itself. By working to educate leaders in government, business, and the non-profit community, environmentalists can advance a sustainability agenda.

Another challenge to infusing sustainability within economic development is that different stakeholders define sustainability in very different ways. To the most concerned about sustainability from an environmental perspective, sustainability is about the measurable improvements we can make to the environment and society via economic development initiatives. To others, sustainability is about business sustainability or the ability to preserve their business activities for a long period. Yet to others, sustainability might be about utilizing resources so that they can be preserved for a long period of time even though there may be other negative environmental or social impacts. In an open economic development process that uses sustainability as a key central theme, definitions are critical to ensure that everyone is using the same sustainability concept. Unless everyone embraces the same meaning of sustainability, it is difficult to successfully implement sustainability within an economic development framework.

Further Reading

Cleaner Greener Consortium of Long Island. 2013. *Cleaner Greener Long Island Regional Sustainability Plan*. file:///Users/gsgrzb/Downloads/Long-Island-CGC-Plan-Report.pdf.

Long Island Regional Economic Development Council. 2011. *A New Vision for Long Island's Economy: The Strategic Economic Development for Nassau and Suffolk Counties*. https://regionalcouncils.ny.gov/sites/default/files/documents/2013/HI-RESFINALLIEconomyBookPRINT.pdf.

———. 2012. *Progress and Promise: Building a Foundation for Long Island's Future: The Strategic Economic Development Plan for Nassau and Suffolk Counties 2012 Update*. https://regionalcouncils.ny.gov/themes/nyopenrc/rc-files/longisland/longisland_2012progressreport.pdf.

———. 2013. *Strong Island: Recovery and Resurgence: The Strategic Economic Development Plan for Nassau and Suffolk Counties 2013 Update*. https://regionalcouncils.ny.gov/themes/nyopenrc/rc-files/longisland/LI-2013-pr.pdf.

———. 2014. *Strong Island: A Continuing Story of Recovery and Resurgence: The Strategic Economic Development Plan for Nassau and Suffolk Counties 2014 Update*. https://regionalcouncils.ny.gov/themes/nyopenrc/rc-files/longisland/LIREDC-2014PR.pdf.

———. 2015. *Promises Made, Promises Kept: A Continuing Story of Progress: The Strategic Economic Development Plan for Nassau and Suffolk Counties 2015 Update*. https://regionalcouncils.ny.gov/sites/default/files/regions/longisland/LIREDC-2015-Progress-Report.pdf.

———. 2016. *Long Island on the Rise: A Region Reaching for New Heights of Innovation and Inclusion: The Strategic Economic Development Plan for Nassau and Suffolk Counties 2016 Update*. https://regionalcouncils.ny.gov/sites/default/files/regions/longisland/LI_ProgressReport2016.pdf.

Long Island Regional Planning Council. 2010. *Sustainable Strategies for Long Island 2035*. https://regionalcouncils.ny.gov/assets/documents/2035-plan.pdf.

New York Regional Economic Development Council. https://regionalcouncils.ny.gov/.

References

Barnett, M.L., N. Darnall, and B.W. Husted. 2015. Sustainability Strategy in Constrained Economic Times. *Long Range Planning* 48: 63–68.

Brinkmann, R. 2016. *Introduction to Sustainability*. Hoboken: Wiley.

Chen, S., R.C. Feiock, and J.Y. Hsieh. 2015. Regional Partnerships and Metropolitan Economic Development. *Journal of Urban Affairs* 38 (2015): 196–213.

Cleaner Greener Consortium of Long Island. 2013. *Cleaner Greener Long Island Regional Sustainability Plan*. file:///Users/gsgrzb/Downloads/Long-Island-CGC-Plan-Report.pdf.

Cobb, J.C. 1993. *The Selling of the South: The Southern Crusade for Industrial Development 1936–1990*. Urbana: University of Illinois Press.

Cohen, B., and P. Muñoz. 2017. Entering Conscious Consumer Markets: Toward a New Generation of Sustainability Strategies. *California Management Review* 59: 23–48.

Downs, M.L. 2014. *Transforming the South: Federal Development in the Tennessee Valley, 1915–1960*. Baton Rouge: LSU Press.

Epstein, M.J., and A.R. Buhovac. 2014. *Making Sustainability Work: Best Practices in Managing and Measuring Corporate Social, Environmental, and Economic Impacts*. San Francisco: Greenleaf Publishing.

Euler, L. 2016. Matt Lauer Wins the Right to Plant Shrubs on Horse Farm. *Curbed Hamptons.* https://hamptons.curbed.com/2016/4/18/11450596/matt-lauer-hamptons-horse-farm.

Giugale, M.M. 2014. *Economic Development: What Everyone Needs to Know*. Oxford: Oxford University Press.

Graeff, P., and G.T. Svendsen. 2012. Trust and Corruption: The Influence of Negative and Positive Social Capital on the Economic Development of the European Union. *Quality and Quantity* 47: 2829–2846.

Green, G.P., and A. Haines. 2011. *Asset Building and Community Development*. 3rd ed. Thousand Oaks: Sage Publications.

Greenwood, D.T., and R.P.F. Holt. 2015. *Local Economic Development in the 21st Century: Quality of Life and Sustainability*. New York: Routledge.

Hanushek, E.A., and L. Woessmann. 2015. *The Knowledge Capital of Nations: Education and the Economics of Growth*. Cambridge: MIT Press.

Jones, B.D. 2017. *The Marshall Plan and the Shaping of American Strategy*. Washington, DC: Brookings Institute.

Jorgenson, D., F.M. Gallop, and B. Fraumeni. 1987. *Productivity and U.S. Economic Growth*. Amsterdam: Elsevier.

Long Island Regional Economic Development Council. 2011. *A New Vision for Long Island's Economy: The Strategic Economic Development for Nassau and Suffolk Counties.* https://regionalcouncils.ny.gov/sites/default/files/documents/2013/HI-RESFINALLIEconomyBookPRINT.pdf.

———. 2012. *Progress and Promise: Building a Foundation for Long Island's Future: The Strategic Economic Development Plan for Nassau and Suffolk Counties 2012 Update*. https://regionalcouncils.ny.gov/themes/nyopenrc/rc-files/longisland/longisland_2012progressreport.pdf.

———. 2013. *Strong Island: Recovery and Resurgence: The Strategic Economic Development Plan for Nassau and Suffolk Counties 2013 Update.* https://regionalcouncils.ny.gov/themes/nyopenrc/rc-files/longisland/LI-2013-pr.pdf.

———. 2014. *Strong Island: A Continuing Story of Recovery and Resurgence: The Strategic Economic Development Plan for Nassau and Suffolk Counties 2014 Update*. https://regionalcouncils.ny.gov/themes/nyopenrc/rc-files/longisland/LIREDC-2014PR.pdf.

———. 2015. *Promises Made, Promises Kept: A Continuing Story of Progress: The Strategic Economic Development Plan for Nassau and Suffolk Counties 2015 Update*. https://regionalcouncils.ny.gov/sites/default/files/regions/longisland/LIREDC-2015-Progress-Report.pdf.

———. 2016. *Long Island on the Rise: A Region Reaching for New Heights of Innovation and Inclusion: The Strategic Economic Development Plan for Nassau and Suffolk Counties 2016 Update*. https://regionalcouncils.ny.gov/sites/default/files/regions/longisland/LI_ProgressReport2016.pdf.

Long Island Regional Planning Council. 2010. *Sustainable Strategies for Long Island 2035.* https://regionalcouncils.ny.gov/assets/documents/2035-plan.pdf.

Mayer, T., F. Mayneris, and L. Py. 2017. The Impact of Urban Enterprise Zones on Establishment Location Decisions and Labor Market Outcomes: Evidence from France. *Economic Geography* 17: 709–752.

Moretti, E., and P. Thulin. 2013. Local Multipliers and Human Capital in the United States and Sweden. *Industrial and Corporate Change* 22: 339–362.

Ng, C.P., T.H. Law, S.V. Wong, and S. Kulanthayan. 2017. Relative Improvements in Road Mobility as Compared to Improvements in Road Accessibility and Economic Growth: A Cross Country Analysis. *Transport Policy* 60: 24–33.

Obermayer, B., and F. Obermaier. 2017. *The Panama Papers: Breaking the Story of How the Rich and Powerful Hide Their Money*. London: Oneworld Publications.

Opp, S.M., and K.L. Saunders. 2013. Local Sustainability Initiatives and the Three E's: Economic Development, Environmental Protection, and Social Equity. *Urban Affairs Review* 49: 678–717.

Patrick, C. 2014. Does Increasing Available Non-tax Economic Development Incentives Result in More Jobs? *National Tax Journal* 67: 351–386.

Reese, L.A. 2013. *Local Economic Development Policy: United States and Canada*. New York: Routledge.

Román, C., E. Congregado, and J.M. Millán. 2013. Start-Up Incentives: Entrepreneurship Policy or Active Labour Market Programme? *Journal of Business Venturing* 28: 151–175.

Ross, J., W. Yan, and C. Johnson. 2014. The Public Financing of America's Largest Cities: A Study of City Financial Records in the Wake of the Great Recession. *Regional Science* 55: 113–138.

Schumacher, E.F. 1973. *Small Is Beautiful: A Study of Economics as If People Mattered*. London: Blond and Briggs.

Szolnoki, G. 2013. A Cross-National Comparison of Sustainability in the Wine Industry. *Journal of Cleaner Production* 53: 243–251.

Todaro, M.P., and S.C. Smith. 2014. *Economic Development*. 12th ed. Philadelphia: Trans-Atlantic Publications.

Van der Krabben, E., and H.M. Jacobs. 2012. Public Land Development as a Strategic Tool for Redevelopment: Reflections on the Dutch Experience. *Land Use Policy* 30: 774–783.

Williams, B., and D. Redmond. 2014. Ready Money: "Residential Over-Development and Its Consequences". In *Neoliberal Urban Policy and the Transformation of the City*, ed. A. MacLaran and S. Kelly. London: Palgrave Macmillan.

Zhang, X., M.W. Warner, and G.C. Homsy. 2017. Environment, Equity, and Economic Development Goals: Understanding Differences in Local Economic Development Strategies. *Economic Development Quarterly* 31: 196–209.

24

Sustainable Business

Deborah Rigling Gallagher

Background

Sustainable businesses consider environmental stewardship and social responsibility goals equal to profit-making goals. They adhere to a triple bottom line philosophy (Elkington 1998) in which firms account for the value of environmentally and socially beneficial actions in addition to accounting for traditional measures such as return on investment and shareholder return. Some sustainable businesses begin with a mission to operate sustainably; others adopt sustainable operations incrementally over time. Many are privately held, but others are large, publicly held firms, which must be accountable to a variety of stakeholders. However, all sustainable businesses adopt an expanded view of stakeholders to whom they are responsible, which extends well beyond those holding stock in the company. Sustainable businesses recognize the value in being transparent about operations; many report progress according to accepted sustainability reporting schemes. Certification schemes are often used to manage operations, track performance, and communicate accountability to the public. Sustainable businesses aspire to high-level environmental goals such as stewardship of biodiversity and water resources and minimizing carbon footprint, and social goals such as inclusion and diversity, employee well-being, and engagement and nurturing community relationships. They focus on environmental impacts throughout their product supply chain. They engage in precompetitive partnerships with other firms,

D. Rigling Gallagher (✉)
Nicholas School of the Environment, Duke University, Durham, NC, USA

R. Brinkmann, S. J. Garren (eds.), *The Palgrave Handbook of Sustainability*,
https://doi.org/10.1007/978-3-319-71389-2_24

governmental organizations, and non-profits to advance progress on critical environmental and social causes. Finally, sustainable businesses increasingly engage in public policy, especially on issues such as global climate change. This chapter first considers each of these characteristics of sustainable companies, providing background and links to the literature. It then provides a case study of Counter Culture Coffee, a small, privately held coffee roaster and supplier, which incorporates many of these attributes. Next, it provides lessons learned from Counter Culture's experience in building and operating a business focused on sustainability. Finally, the chapter offers insight into the barriers and challenges that companies like Counter Culture face.

Expanded View of Stakeholders

Businesses with a focus on sustainability recognize that when a variety of stakeholders' perspectives are considered, products and services will be less likely to create negative environmental impacts and more likely to create social benefits. When sustainable businesses consider the views of neighbors, community groups, and advocacy organizations, they gain a strategic resource—ground-level knowledge about critical environmental and social issues. This knowledge may be converted into actions, such as proactive environmental behaviors, which increase trust and protect reputational assets. Businesses which engage a variety of stakeholders, including "fringe" stakeholders such as the natural environment itself (Hart and Sharma 2004), are more likely to implement creative, even disruptive, environmental management strategies and weather environmental and social crises. For example, in the much maligned extractive industries such as forestry and mining, sustainable businesses, which engage stakeholders in government and civil society to jointly develop practices to protect community assets and biodiversity, are more likely to retain a social license to operate, rather than continually face, protests over operations (Boiral and Heras-Saizarbitoria 2015).

Leading sustainable businesses engage regularly and systematically with a wide variety of stakeholders: customers, suppliers, community members, and investors, gathering data on their concerns and reflecting on them to change practices as needed (Mason and Simmons 2014). These companies design and implement mechanisms to engage with stakeholders in a variety of spaces such as social media, global conferences, and local community meetings. Unilever, a leading practitioner of stakeholder engagement, piloted the "Unilever Sustainable Living Lab", an online forum which brings together

stakeholders from academia, non-profits, government, and business to discuss critical issues such as sustainable sourcing and consumer behavior change. Businesses such as Walmart, British Telecom, Nike, and Coca-Cola use Twitter to engage in conversations with stakeholders about sustainability.

Transparent Operations

Transparency is a critical practice for sustainable businesses. In an era of social networking, employees, government agencies, stockholders, consumers, and community members alike have the ability to share information about business practices with a wider public. Increasingly, businesses seeking to establish a culture of trust with employees, suppliers, and customers and build a reputation as a sustainability leader make information about environmental compliance, environmental footprint, and progress on meeting social goals easily accessible. While the value of transparency is contested, its practice is increasingly a critical practice in managing business value chains (Mol 2015). Companies are engaged in three types of sustainability reporting: integrated, specialized, and single focus. Integrated reporting covers three dimensions of sustainability: financial, environmental, and social. Specialized sustainability reporting is most common; here companies offer a joint picture of progress on social and environmental issues, recognizing that financial reporting is routine and commonplace. Such reports are generally offered as corporate citizenship or corporate social responsibility reports. Finally, companies, most often on their own websites, parse environmental and social performance into distinct progress reports.

Specialized sustainability reporting is increasingly reliant on platforms such as the Global Reporting Initiative (GRI) or the Carbon Disclosure Project (CDP) to highlight environmental and social sustainability efforts. Businesses collect information on environmental and social sustainability activities and report that information according to standard, established protocols. Stakeholders can then easily make comparisons of companies' behavior. The best reports are those that offer information on critical issues, have been developed through a process of stakeholder inclusion, offer data on both positive and negative performance, are accurate, and based on reliable data.

The widely used GRI protocol most notably includes a framework to consider impact materiality at the outset. A materiality assessment, a systematic and transparent examination of the environmental and social impacts to be reported, takes both business goals and stakeholder concerns into account.

Fig. 24.1 Sustainability materiality matrix (Source: http://www.3m.com/3M/en_US/sustainability-report/strategy/sustainability-materiality-process-and-outcomes)

Leading companies using the GRI as a transparent communication tool offer materiality matrices in their reports, graphically depicting individual impacts' significance against their importance to stakeholder expectations, as shown in Fig. 24.1.

Certifying Progress

Some firms go beyond simply reporting progress to having their efforts audited and certified by third-party institutions such as B Lab and the International Organization for Standardization (ISO). Certification comprises a process of choosing an appropriate standard to measure progress against, developing a system of metrics and measurements according to that system, and engaging an auditor to verify conformity. Certification of overall business environmental and social impacts is used more and more by leading

companies (Epstein and Buhovac 2014), and sector-specific certification systems such as Rainforest Alliance Certified (food and tourism) and Forest Stewardship Council (forestry) are available. However, research shows a weak link between producer economic benefit, social and environmental impacts, and certification in these sectors such as food, forest products, and tourism (Blackman and Rivera 2011).

The non-profit organization B Lab, created in 2006, offers a suite of standards against which businesses can assess social and environmental performance, transparency, and accountability behavior. With B Lab's assistance businesses may become a certified B Corp by first assessing impact against standards and receiving a minimum score of 80 out of a possible 200-point set of criteria. Criteria are organized into four buckets: environment, workers, customers, and community and governance. Following this companies seeking to be a certified B Corp must either outline a process by which the business would become a certified B corporation by incorporating stakeholder sustainability interests into board governance mechanisms or provide documentation of existing mechanisms. Required governance mechanisms focus on accountability to all stakeholders, rather than simply those with a financial stake and transparency. To date the over 1800 certified B Corps have largely been privately held companies, including industry leaders such as Ben & Jerry's, Etsy, and Patagonia. Leading companies report that the exercise of conducting a B Impact Assessment is valuable in highlighting areas for improvement and providing a platform for comparison (B Impact Assessment 2016).

Alternatively, businesses may choose to certify that their environmental management systems adhere to the ISO 14001 standard. To do so companies apply a standardized plan-do-check-act, continuous improvement framework, to tailor a company-specific environmental management system, annually monitor progress against goals and objectives, report progress to stakeholders, and modify the system to implement necessary improvements. Auditors both assist in building and implementing the system and certifying that the system meets ISO 14001 requirements. Since its inception in 1996 ISO 14001 certification has been achieved by over 300,000 companies across the globe. Considerable research has been devoted to understanding firms' use of ISO 14001 and the economic and environmental benefits of doing so (Nawrocka and Parker 2009). Historically, leading global firms, most notably in the electronics and automotive industry, used ISO 14001 certification to leverage suppliers to improve environmental management practices by requiring them to become certified. However, certification of US and EU firms has lagged in recent years, with few additional firms obtaining certification. Most

new uptake in ISO 14001 certification occurs in Asia and South America, where environmental regulations are less rigorously enforced, and businesses use certification as a signal to customers that environmental impacts are well managed (Berliner and Prakash 2013).

Focus on Social Goals

Sustainable businesses seek to measure progress beyond environmental stewardship, setting goals and critically examining their efforts to increase organizational diversity and inclusion, address poverty and gender inequality, foster employee engagement, and build stronger relationships with community members and other external stakeholders. Leading sustainable businesses may also seek to measure progress against the United Nations Sustainable Development Goals (SDGs). The SDGs were consensually developed by United Nations (UN) member states and stakeholders from civil society and formally declared in UN resolution A/RES/&0/1 in September 2015. The SDGs offer a global plan of action for making specific progress on issues such as gender equality, poverty reduction, clean energy access, and climate change by 2030. The 17 SDGs (https://sustainabledevelopment.un.org/) comprise 169 targets to be applied in addressing each critical issue area. For example, goal 13, Climate Action, states, "Take urgent action to combat climate change and its impacts", and offers five specific targets for civil society actors to focus upon, such as target 2, "Integrate climate change measures into national policies, strategies and planning". Moreover, goal 11, Sustainable Cities and Communities, calls on actors to, "Make cities and human settlements inclusive, safe, resilient and sustainable", by focusing on targets such as, "Support least developed countries, including through financial and technical assistance in building sustainable and resilient buildings utilizing local materials". The SDGs are depicted in Fig. 24.2.

If the SDGs are to be a force in creating a sustainable global society, businesses must play a critical role (Hajer et al. 2015). Leading companies are increasingly organizing overall sustainability work around the SDGs by incorporating them into their strategic management goals. For example, Novozymes, which was recently named a Local SDG Pioneer by the United Nations Global Compact, assesses its products and services according to their ability to address global social issues such as poverty and climate change. Novozymes uses the SDGs to set company priorities for business development and to develop partnerships.

Fig. 24.2 Sustainable Development Goals (Source: http://www.un.org/apps/news/story.asp?NewsID=51968#.V88yvzW4c8U)

Supply Chain Management

Sustainable businesses recognize the environmental and social impacts of their product and service supply chains. Sustainable supply chain management (SSCM) has increasingly become a focus of academics and practitioners alike (Ageron et al. 2012). At each step of the supply chain from access to raw materials to production to customer use, environmental impacts are created and must be managed. Current research on SSCM indicates that businesses seeking to behave sustainably must consider impacts throughout the life cycle, including product design, both manufacturing and customer use by-products, and end-of-use impacts (Linton, et al. 2007). Suppliers' operations are also founded on employee engagement and unique community and stakeholder relationships. Practices which address social goals, such as fair labor standards, worker safety, and transparency, must be in place throughout the supply chain.

Sustainable businesses seek to minimize environmental impacts by working with suppliers to decrease their environmental footprints. This can take the form of mandates for environmental emission reduction as a condition of doing business, the provision of environmental stewardship education and training, or both. The UK-based grocer Tesco promotes sustainable behaviors among suppliers by requiring them to meet standards and offering opportunities for networking and training. These practices earned the company Ethical Consumer's best rating for Supply Chain Management in 2016. Leading

companies also provide detailed supply chain information to consumers. For example, Patagonia offers an interactive map on the company website showing the locations and attributes of its global network of farms, factories, and textile mills. Visitors to the website are able to trace the production journey of individual items. Marks and Spencer and Nike offer detailed interactive maps showing global factory locations.

Partnering

Sustainable businesses acknowledge that partnering with organizations which possess complementary resources is a useful approach to make progress on sustainability goals (Winston 2014). Leading sustainable businesses have long partnered with non-profit and government organizations to address environmental and social issues. Beginning in the 1990s companies like McDonald's and Walmart partnered with environmental NGOs such as Environmental Defense to work on issues such as packaging waste and renewable energy. Businesses like ArcelorMittal and Barrick Gold partner with Conservation International to develop community-level solutions to conserve biodiversity at mining sites. McDonald's partners with Greenpeace to address deforestation in the Brazilian Amazon.

Companies in specific economic sectors have long worked in trade associations to address mutual issues, such as tax policy. Sustainability associations, such as the Sustainable Apparel Coalition, operate as a platform for companies to learn about sustainable manufacturing practices. The United Nations Global Compact serves a global convening space and learning organization for members to share best practices in service of sustainability (Gallagher 2014). Finally, leading sustainable businesses increasingly recognize the benefits of working with direct rivals, in precompetitive partnerships. These partnerships leverage combined knowledge assets to address issues which have an impact beyond company boundaries. For example, 29 companies, including The Coca-Cola Company, Unilever, Nestle, and PepsiCo recently partnered to develop Collectively (https://collectively.org), a social media platform which motivates global action on climate change by sharing success stories.

Engaging in Public Policy

Sustainable businesses are increasingly recognizing that making progress on social and environmental sustainability requires engagement in public policy. Issues such as climate change, access to clean water, poverty, and racial inequality

demand attention from business leaders who seek to promote sustainability. Sustainable business leaders have begun to responsibly engage in efforts to influence public policies which would address these issues. Responsible engagement begins with work to align company-wide messaging on issues of consequence (United Nations Global Compact 2013) to reflect sustainability goals and objectives. For example, employees participating in professional or trade organizations must be careful to reflect company positions on issues such as climate change.

A recent initiative of the United Nations Global Compact brought stories of sustainability leaders from companies such as Microsoft, Abengoa, Ben and Jerry's, and Statoil to the 21st Conference of the Parties in Paris to lobby for a price on carbon as a tool to combat climate change. Over 60 companies declared themselves carbon pricing leaders (United Nations Global Compact 2015) in an act of collaborative environmental leadership (Gallagher 2016).

Sustainable Business Case Study

While many high-profile, publicly held multinational corporations are at the forefront of sustainable business, the engines of this movement are small- and medium-sized businesses, many of them privately held. Such small businesses have little slack resources to put toward sustainability efforts, which leads them to discover innovative approaches, such as partnering with competitors and those in their supply chain, to critically address issues. In addition, they are often strongly focused on company mission and free from certain reporting requirements, which clears a path to experimentation. This chapter considers a case study of a small but growing privately held coffee supplier at the forefront of the sustainable business movement. From Counter Culture's experience we learn about the value of experimentation that establishing relationships and forming partnerships with a variety of stakeholders is key to success and that both successes and failures must be measured and widely communicated.

Counter Culture Coffee

Counter Culture Coffee was founded in 1995 by two friends seeking to source, roast, and distribute beans to local restaurants in the Durham, North Carolina area. The two, Brett Smith and Fred Houk, wanted to build a coffee network based on quality beans and long-term relationships with customers and growers. Fred, an avid bird watcher, was interested in minimizing the

environmental impact of coffee production. Brett, who serves as the president today, recognized that environmental impacts would be one part of the company's sustainability story, but that making profits and nurturing relationships with employees, customers, and growers would also be critical components. The company they built focuses on the three legs of sustainability; their mission states that "Counter Culture is committed to real social, environmental and fiscal sustainability".

Counter Culture, which now sells over 2.5 million pounds of coffee beans annually, focuses not only on sourcing, roasting, and distributing beans but also on an aspect critical to its mission—providing education on coffee. The company comprises roasteries in Durham and in Emeryville, California, and 11 regional training centers across the United States. The training centers offer courses in all matters of coffee to employees and wholesale customers as well as public tastings and home brewing basic lessons for the public. Establishing and managing long-term relationships with growers across the globe is a centerpiece of Counter Culture. Leading edge practices enable employees to collaborate with local growers to produce quality beans that garner a fair price and minimize impacts on the environment.

Counter Culture's Business Model

Counter Culture sources its beans in two ways. A small percentage (3 percent in 2015) is sourced on the worldwide spot market in which coffee, a commodity, is traded immediately according to a daily price. Most coffee is single origin, sourced through farmers or cooperatives who enter into contracts and engage in long-term relationships. Staff work with growers worldwide to ensure quality and provide education and outreach on sustainability principles and practices. Partner growers are paid a fair price for beans, often well in excess of industry standards. The beans are imported to the company's two roasteries and then made available to customers who are largely wholesale suppliers. Ultimately the product reaches coffee consumers as shown in Fig. 24.3.

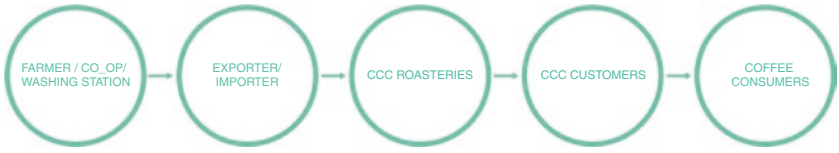


Fig. 24.3 Counter Culture coffee supply chain (Source: https://counterculturecoffee.com/2015report/)

Counter Culture's Sustainability Practices

Counter Culture works to *minimize the environmental impacts* of coffee bean production, roasting, and distribution. Energy efficiency is a focus at the company's roasteries in Durham and Emeryville. Counter Culture purchases wind energy credits to partially offset its carbon footprint. The company also supports sustainable forestry projects and buys offsets in the regions in which they purchase beans. Waste diversion rates are increasing at the Durham headquarters through better practices and sorting technology. Finally, employees have an opportunity to receive financial support from Counter Culture to engage in personal sustainability projects.

Counter Culture *gives back to the community*. In Durham, North Carolina, the company partners with SEEDS, an urban educational garden, which is located adjacent to its headquarters. SEEDS uses sustainable urban gardening as a vehicle to build leadership skills of neighborhood youth. The company provides support in coffee growing regions to partner farmers and coops to undertake projects such as building housing for local teachers and creating composting programs for organic materials. Staff volunteer their time with the Coalition for Coffee Communities, which the company also funds, and the Catholic Relief Services Borderlands Advisory Council, which supports smallholder coffee growers in Colombia.

Counter Culture *partners with key organizations*. For example, a long-standing partnership with faculty and students at Duke University's Nicholas School of the Environment has focused on developing strategies to reduce the company's carbon footprint and to help partner growers adapt to climate change. The company's goal is to reduce their carbon footprint by 30 percent of the 2014 level by 2017 and for 75 percent of their growing partners to have a climate change adaptation plan in place over the next year. Professional staff collaborate with other industry professionals to create sustainability standards as members of the Specialty Coffee Association of America's Sustainability Council. The company also participates in Conservation International's Sustainable Coffee Challenge with small distributors like themselves and industry giants like Starbucks, which seeks to make coffee a completely sustainable agricultural product.

Finally, Counter Culture *values transparency and communication*. The company annually collects detailed information on social, environmental, and financial performance. Counter Culture's website offers detailed information on every aspect of the company's work from a map showing global locations of suppliers, reports of field trips to growers, reports from regional training centers, and reports on progress in achieving the company's mission to enact social, environmental, and fiscal sustainability.

Lessons Learned

Counter Culture's success over its 20+-year history is largely due to its emphasis on collaboration, transparency, and reflection. The company is a living example of how these principles can serve as bedrock for a sustainable enterprise, morphing from a small-scale local coffee bean distributor to a country-wide resource for quality beans from around the globe. Interviews with the company's current and former sustainability directors, Meredith Taylor and Kim Elena Ionescu, highlight the company's journey and the lessons they have learned about how to practice sustainability.

Kim Elena Ionescu served as the company's first sustainability manager, a position created for her in 2007 to complement her half-time job as grower relationship manager. Kim now works as the sustainability director for the Specialty Coffee Association, which serves farmers, roasters, and baristas across Europe and America. From its beginning Counter Culture relied on a vision statement which incorporated sustainability to bake the concept into the DNA and culture of the growing small business. This enabled Kim to experiment with approaches to being a sustainable business, to work to "harmonize thinking about how to express sustainability to Durham and in other communities, to find a philosophy that would tie the two ends of the supply chain together".

Counter Culture's quest for alignment is a characteristic of other small companies, which must, given resource constraints, begin with what's important and as Kim notes, "use that as an entry point". Counter Culture's entry point was sustainable agriculture, both from an environmental and a social perspective. The company's experimental sustainability program was built on outreach and education to growers and communities. The company shared the stories of its journey with others, seeking to be an influencer, "to share not just what's going well, but what didn't work and wasn't always tangible and visible". In this way Counter Culture was a "smallish company that acted like it had a larger reputation".

Meredith Taylor took over as a full-time sustainability director for Counter Culture in 2014. She sees her job as composed of three key aspects: imagining and implementing a sustainable coffee supply chain, focusing on the social and environmental aspects of operations, and telling the Counter Culture story. Her work always begins with the supply chain. She sees the work of companies like Counter Culture as beginning "wherever people are at with quality and sustainability in growing coffee and helping them keep moving forward". Meredith has worked on developing sustainability metrics for coffee along the lines of metrics for bean and brewed coffee quality the industry has

long relied on. She also works to improve energy efficiency and to minimize environmental impacts of the company's headquarters, roasteries, and training centers, describing this as a process of "learning by doing".

Serving as a business leader for sustainability, improving communication, and partnering are key components of Counter Culture's sustainability program. Meredith states that leadership comes from letting others know that they don't have to completely "figure out sustainability before they do anything about it. They don't have to try really hard on the process and planning side of it and have it all defined and laid out before they get to work". Counter Culture's way has been to experiment and learn from successes and failures. The company also values formal reporting and creates an annual transparency report which covers all aspects of its operations, though as a privately held company, this is not a requirement. Meredith offers that she "wants other companies to copy us". Finally, Meredith guides the company's evolving suite of sustainability partnerships, most of which are with multiple partners and take a landscape approach. For example, one initiative in Guatemala partners Counter Culture with competitors, importer/exporters, and local NGOs to help create strategies for adaptation to climate change.

In summary, these lessons from Counter Culture can be adapted to other businesses seeking to incorporate real and long-lasting sustainability into operations:

- Know your customers and your suppliers. Build relationships with them.
- Experiment.
- Measure successes and failures. Communicate them to a wide audience.
- Partner with others on issues of common concern.

Challenges and Barriers

Counter Culture is a small, privately held company, which offers a culture open to experimentation. Larger, publicly traded companies will find barriers to such experimentation. In addition, challenges are increasingly presented by sustainability reporting commitments and the inherent risks in making information public. The widespread use of social media (especially Twitter and Facebook) to communicate progress means that messages will need to be honed and simplified. Accuracy will be a challenge and risks of misinterpretation must be considered.

Both Counter Culture's sustainability managers described sustainability as being "messy". In a business environment, which operates on quarterly financials,

the investments needed to increase sustainability of operations do not often provide paybacks within standard timeframes. Government support for environmental and social initiatives is waning, and regulatory requirements to require standard sustainability behaviors are not likely to be put in place. This increases the messiness. Businesses are speaking out about the need for global standards of sustainability behavior, especially as related to limiting the impacts of climate change. Fortunately, businesses like Counter Culture are focusing on the sustainability of supply chains. They are also confronting barriers to sustainability by creating robust precompetitive partnerships and engaging in policy advocacy.

Further Reading

Ageron, B., A. Gunasekaran, and A. Spalanzani. 2012. Sustainable Supply Management: An Empirical Study. *International Journal of Production Economics* 140 (1): 168–182.

B Impact Assessment Case Studies: 15,000+ Businesses Are Using This Tool to Improve Their Business. Here's What They're Saying About Their Experience. http://bimpactassessment.net/case-studies. Accessed 1 Aug 2016.

Berliner, D., and A. Prakash. 2013. Signaling Environmental Stewardship in the Shadow of Weak Governance: The Global Diffusion of ISO 14001. *Law & Society Review* 47 (2): 345–373.

Blackman, A., and J. Rivera. 2011. Producer-Level Benefits of Sustainability Certification. *Conservation Biology* 25 (6): 1176–1185.

Boiral, O., and I. Heras-Saizarbitoria. 2017. Managing Biodiversity Through Stakeholder Involvement: Why, Who, and for What Initiatives? *Journal of Business Ethics*: 140 (3): 403–442.

Elkington, J. 1998. Partnerships from Cannibals with Forks: The Triple Bottom Line of 21st-Century Business. *Environmental Quality Management* 8 (1): 37–51.

Epstein, M.J., and A.R. Buhovac. 2014. *Making Sustainability Work: Best Practices in Managing and Measuring Corporate Social, Environmental, and Economic Impacts*. San Francisco: Berrett-Koehler.

Gallagher, Deborah Rigling. 2014. The United Nations Global Compact: Forum for Environmental Leadership. In *The UN Millennium Development Goals, The Global Compact and the Common Good*, ed. Oliver Williams, 271–281. South Bend: Notre Dame University Press.

Gallagher, D.R. 2016. Climate Change Leadership as Sustainability Leadership: From the C-Suite to the Conference of the Parties. *Journal of Leadership Studies* 9 (4): 60–64.

Hajer, M., M. Nilsson, K. Raworth, P. Bakker, F. Berkhout, Y. de Boer, and M. Kok. 2015. Beyond Cockpit-ism: Four Insights to Enhance the Transformative Potential of the Sustainable Development Goals. *Sustainability* 7 (2): 1651–1660.

Hart, S.L., and S. Sharma. 2004. Engaging Fringe Stakeholders for Competitive Imagination. *The Academy of Management Executive* 18 (1): 7–18.

Linton, J.D., R. Klassen, and V. Jayaraman. 2007. Sustainable Supply Chains: An Introduction. *Journal of Operations Management* 25 (6): 1075–1082.

Mason, C., and J. Simmons. 2014. Embedding Corporate Social Responsibility in Corporate Governance: A Stakeholder Systems Approach. *Journal of Business Ethics* 119 (1): 77–86.

Mol, A.P. 2015. Transparency and Value Chain Sustainability. *Journal of Cleaner Production* 107: 154–161.

Nawrocka, D., and T. Parker. 2009. Finding the Connection: Environmental Management Systems and Environmental Performance. *Journal of Cleaner Production* 17 (6): 601–607.

United Nations Global Compact A: Guide for Responsible Engagement in Climate Policy. 2013. https://www.unglobalcompact.org/docs/issues_doc/Environment/climate/Guide_Responsible_Corporate_Engagement_Climate_Policy.pdf. Accessed 1 Aug 2016.

United Nations Global Compact B: Executive Guide for Carbon Pricing Leadership. 2015. https://www.unglobalcompact.org/docs/issues_doc/Environment/climate/CarbonPricingExecutiveGuide.pdf. Accessed 1 Aug 2016.

Winston, A. 2014. *The Big Pivot: Radically Practical Strategies for a Hotter, Scarcer, and More Open World*. Cambridge, MA: Harvard Business Review Press.

25

Contributing to Competitiveness in Retailing by Engaging in Sustainability: The Case of Migros

Thomas Rudolph, Kristina Kleinlercher, Marc Linzmajer, and Cornelia Diethelm

Recent Developments and Theoretical Background

Customer demands in terms of sustainability are becoming more insistent than ever before. In Switzerland, an increasing number of customers are interested in the origin of their groceries (eight out of ten customers in 2015). The number of customers who prefer to buy locally produced groceries grew by 13 percent between 2013 and 2015. Preference for suppliers that engage in social sustainability also grew by 13 percent in this period of time (Rudolph et al. 2015a). Companies have realized that sustainably produced goods are no longer an add-on in daily business; rather they are a principal requirement. However, the economic benefits of sustainability are not well understood in many organizations. Experts report about companies failing with their sustainability initiatives because they lack a clear vision and strategy behind it (Etsy and Winston 2009). In the course of a worldwide survey among 2600 managers, Kiron et al. (2013) found that only 37 percent of the respondents report that their company increased its competitiveness via sustainability actions. Nidumolu, Prahald, and Rangaswami (2009) highlight companies' concerns that sustainability initiatives solely add costs and erode competitiveness. For this reason, many Chief Executive Officers (CEOs) treat sustainability initiatives detached from business objectives.

T. Rudolph • K. Kleinlercher (✉) • M. Linzmajer
University of St. Gallen, St. Gallen, Switzerland

C. Diethelm
Migros-Genossenschafts-Bund, Zurich, Switzerland

R. Brinkmann, S. J. Garren (eds.), *The Palgrave Handbook of Sustainability*,
https://doi.org/10.1007/978-3-319-71389-2_25

The question arises how companies may integrate sustainability into their business activity to ensure competitiveness in the long term. Little is known about the factors influencing the effect of sustainability initiatives on the profit generation process. Sheth, Sethia, and Srinivas (2010) introduce the concept of mindful consumption as an essential factor in guiding organizations' sustainability actions. According to the authors, companies need to focus on a customer-centered approach to sustainability. Sustainability initiatives shall appeal to customers' sense of caring toward self, community, and nature and activate a mindful consumption. Sheth et al. (2010) do not investigate the effect of sustainability initiatives on a company's competitiveness. Nidumolu et al. (2009), on the other hand, define five district stages of change necessary when striving for successful sustainability: (1) viewing compliance as an opportunity to create first-mover advantage, (2) working on sustainable initiatives along the entire value chain, (3) designing innovative products and services, (4) reinventing business models, and (5) developing knowledge exchange platforms to jointly elaborate next practices. Similarly, Kiron et al. (2013) identify four key elements central to the success of sustainability initiatives: (1) commitment from the top management, (2) collaborations with customers and non-profit organizations, (3) business model innovations, and (4) adaptations in the organizational structure. This case study on sustainability initiatives of the Swiss grocery retailer Migros intends to contribute to research and management practices on ingredients of successful sustainability initiatives. It assesses which factors, already identified in literature, hold true in a retailing context and identifies additional, so far unknown, success factors for competitive sustainability.

Case Study: Migros

Introduction

February 2, 2015: The media release saying that Migros is awarded the most sustainable retailer worldwide has just been sent out. Within the last 12 months, the independent rating agency Oekom Research analyzed 140 different retailers for their sustainability performance using more than 100 environmental and social criteria (Oekom 2015). Switzerland's largest retail company, Migros, is ranked first, well ahead of others such as Marks and Spencer, Tesco, Carrefour, or Metro. Migros is the only retailer that managed to be graded with B+ (good) when it comes to sustainability.

It has been a long and winding road from Migros' beginnings in 1925 to the present. Sustainability has always been part of Migros' corporate philosophy. The company's strong engagement in economic, environmental, and social sustainability is one of the reasons that makes Migros one of the Top 15 most attractive employers in Switzerland (Universum 2016). Nevertheless, tremendous changes in the Swiss retail landscape within the last years rendered sustainable actions at Migros more complex than ever before. The market entry of the German discounters Aldi in 2005 and Lidl in 2009 put a lot of pressure on food and beverage prices in Switzerland. For example, in January 2015, Aldi started offering frozen pizzas for 0.99 Swiss francs and small bread for 0.49 Swiss francs. Both offers are by far the cheapest in Switzerland. However, threats for Migros' success do not only lurk inside the country—cross-border shopping has become a popular phenomenon lately. In particular, since the discontinuing of the minimum exchange rate of 1.20 CHF per Euro in January 2015, shopping for groceries, cosmetics, and the like across borders has lowered consumer spending in Switzerland (Rudolph et al. 2015b). Apart from growing competition in and outside of Switzerland, Swiss consumers are becoming more critical and demanding than ever. Due to the rise of the Internet, new avenues of transparency open up: Consumers are able to access information concerning the price, the quality, and the origin of retailers' products. With sustainable products, retailers have the chance to convincingly stand out from competition. However, as discounters are also investing in sustainability and as standards on sustainability are becoming ever more demanding, increasing competitiveness with sustainability initiatives is not at all an easy task.

The Swiss retailer Migros reacted to these developments by focusing on high-quality and sustainably produced goods. Quality labels such as *TerraSuisse*, *Migros Bio*, or *Bio Cotton Migros* (Fig. 25.1) testify Migros' engagement for sustainability. In sum, there are 12 different labels that mark

Fig. 25.1 Quality labels for Swiss products

sustainable products at Migros. Customers may calculate the share of sustainable products in their shopping baskets, if they own a Migros loyalty card. Thanks to this service, Migros managed to increase customer awareness when it comes to sustainability. A survey with more than 1000 participants from September 2015 showed that 35 percent of Migros customers check the share of sustainable products in their shopping baskets on a regular basis. In 2016, 20 percent of all the products purchased at Migros supermarkets came from sustainable sources.

The entire Migros team feels proud of the award denoting Migros as the most sustainable retailer. Together they have proven that sustainability is not solely a costly marketing measure to improve a company's image; rather it is part of a company's business strategy that is present in every corner of the company. Sustainability may contribute to a company's competitive advantage if implemented wisely. But how exactly did Migros manage to strengthen its competitiveness with sustainability?

About Migros

For more than 90 years now, Migros is operating in the Swiss retail market. Gottlieb Duttweiler (* 1888, † 1962), a visionary with a strong sense for social justice, founded the company in 1925 in Zurich. It was Gottlieb Duttweiler's goal to offer Swiss customers value for money. Migros started by selling only six different products with the help of Ford trucks in 1925. Today, the Migros group comprises numerous supermarkets, specialty shops, production facilities, trading firms, and holdings. With 659 sales locations spread all over Switzerland, Migros generated sales of 15.6 billion Swiss francs in 2015. The product range in the supermarkets is composed of up to 40,000 different products by 2015.

Migros realized early that the typical characteristics of Swiss products (reliability, accuracy, naturalness, and cleanness) are beneficial to consumers. For this reason, 80 percent of the entire product range consist of private-label products. These are mainly produced by Swiss company-owned production plants. Ranging from meat and dairy to canned food and cosmetics, Migros' private-label products have become an integral part of Swiss households. By producing large parts of the assortment in-house, Migros saves delivery costs, minimizes inventory shortfalls, and offers its customers high-quality Swiss products with a reduced ecological footprint.

Migros consists of ten regional cooperatives guided by a cooperative alliance. 2.16 million Swiss citizens and households—that is, nearly a quarter of the entire Swiss population—hold shares in Migros. Migros' guiding princi-

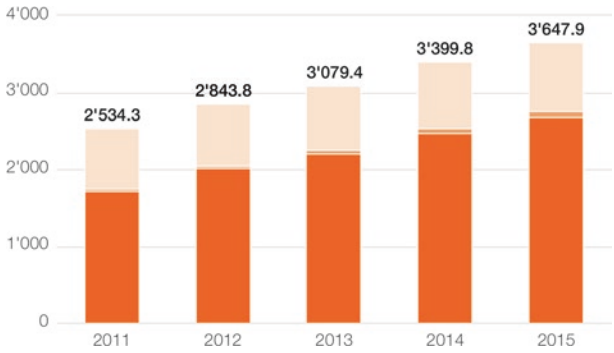


Fig. 25.2 Total sales of Migros' sustainability, regionality, and healthcare labels (in million Swiss Francs)

ple underlines its passion for delivering consumers the highest possible quality of life. Investing in in-house production, collaborating with Swiss farmers to promote sustainable agriculture in Switzerland, and keeping common welfare constantly in mind turned out to be advantageous for Migros. Total sales of Migros' sustainable, regional, and healthcare products increased steadily since 2011 (Fig. 25.2). In 2015, sustainable, regional, and healthcare products generated 26 percent of total retail sales at Migros.

At Migros, sustainable corporate management is not simply a means to communicate the company's goodwill. For this reason, Migros sees the concept of Corporate Social Responsibility (CSR) a bit different from several other businesses. Companies should not solely engage in sustainability because of legal pressure and customer demands. Instead of thinking about how to use business profits for sustainable actions, Migros looks for ways to increase the welfare of its consumers and its environment, while at the same time trying to increase its competitiveness with sustainable actions. Clearly, this is not an easy task, but it is manageable when one looks at Migros' sustainability initiatives within the last years.

Organizational Anchorage of Sustainability

Since sustainability is an integral part of Migros' business activity, every company member—from the CEO to the frontline employee—may deposit his/her ideas for sustainability projects. Still, Migros has a department which is dedicated exclusively to sustainability issues (Sustainability and Issue Management) and which reports directly to the CEO. The department discusses all kinds of sustainability ideas (coming from either the headquarters or the cooperatives) and analyzes them for their environmental and societal

impact as well as their economic utility. Furthermore, Sustainability and Issue Management at Migros shares and integrates the expertise about sustainability within the entire company.

Being a cooperative alliance, decision-making in the area of sustainability is not exclusively reserved to members of the Migros headquarters in Zurich. Ten regional cooperatives engage independently in sustainability within their geographical area. They stick up for fair working conditions, the regionality of the assortment, cultural wealth in their region, environmental protection, and the like. In addition to their engagement for sustainability within their area, the cooperatives contribute their share to nationwide sustainability initiatives that are developed together with the headquarters. To implement nationwide initiatives efficiently in the different geographical areas, regional cooperatives and the centralized sustainability department work closely together to foster knowledge sharing. Given that sustainability initiatives are developed, discussed, and implemented by employees of various business areas, regions, and hierarchical levels, a large amount of expertise and experience comes together in each single initiative.

In the spirit of the company's founder Gottlieb Duttweiler, Migros' top management engages constantly in sustainability initiatives. Herbert Bolliger (CEO Migros from 2005 until 2017) strongly believes that it is Migros' duty to inspire not only its employees but also its entire customer base with the merits of sustainability. For instance—together with a top chef—he cooks with children to motivate them for the art of cooking with sustainable ingredients. In collaboration with the World Wide Fund for Nature (WWF), Migros created a cookbook called *Green Gourmet Family* to promote healthy, well-balanced, environmentally conscious nutrition. According to current research, 87.2 percent of managers strongly believe that the success of sustainable management relies heavily on the commitment of the top management team (IRM 2014). When thinking about Bolliger's engagement in sustainability, a quote of Doug Campbell, former CEO at Campbell Group, comes to one's mind: "You can talk about making it a priority, but if you don't organize to do it in a priority way, it doesn't get done. It has to have a line that gets all the way up to the CEO in a compelling way."

Initiatives at Migros

Generation M

There are numerous laws and regulations, which govern the everyday business of a Swiss retailer. Ranging from food hygiene standards to (il)legitimate indications on the packaging, the list is endless. For Migros, obeying these

regulations is not yet enough to protect society and environment. Already in 1959, Gottlieb Duttweiler realized that the bigger a company, the greater its responsibility to work on solutions for problems of humanity. For this reason, Migros took on the task of actively contributing to the well-being of tomorrow's generation. Under the name *Generation M*, Migros makes binding promises to tomorrow's generation in the areas of environmental protection, encouragement of sustainable consumption, dealing fairly with employees, healthy lifestyle, and support of common welfare on a regular basis. For instance, Migros promises the little girl Manon to invest one billion Swiss francs into education and culture until 2020, whereas Migros promises Moritz to sell only fish products coming from sustainable sources until 2020 (Fig. 25.3).

Transparency of information is of utmost importance at Migros. The progress of the achievement of the promises is monitored two times a year, discussed internally (with the Directorate-General members, the heads of the ten cooperatives, and the heads of the Migros industry), and communicated to public twice a year on the Migros website (Migros 2015; note: visit the link in the reference list to take a look at Migros' published progress of the achievement of promises; only available in German). Consumers may browse through Migros' website to find out the status of each promise, which is visualized via a traffic light system (red for failed, orange for offtrack, light green for on track, and dark green for fulfilled). Not only achieved goals but also missed targets are communicated. In addition, Migros shares the (non-)achievement of the promises in its annual sustainability report and on its intranet.

In 2013, Migros decided to make a promise to tomorrow's generation concerning meat. To ensure animal welfare even outside of Switzerland, Migros promises Swiss children that by 2020 it will solely source meat from foreign farmers if they fulfill the strict Swiss animal welfare standard. Since the Swiss animal welfare standard requires 30–40 percent more space for the animals in the stables than the EU standard, this promise demands a great deal of work for Migros. Another promise from *Generation M* that extends beyond national

Fig. 25.3 Promises to tomorrow's generation (in German)

borders concerned the working conditions at Migros' suppliers. Migros promised the young boy Chaiwat to actively ameliorate the working conditions of 75,000 employees from Migros' suppliers until 2015. As Migros operates a giant network of suppliers (e.g., around 2000 in Asia alone), this promise was vital for Migros' advances in social sustainability. The promise could be held, thanks to several initiatives: Migros collaborated with the International Labor Organization (ILO) and the International Finance Corporation (IFC) to train factory workers in safety issues at the workplace. Furthermore, Migros cofounded the Business Social Compliance Initiative (BSCI)–a standard that poses specific requirements regarding health, security, and working conditions for suppliers. All of Migros suppliers abroad have to follow this standard and are monitored on a regular basis.

By complying with social and ecological standards that are not (yet) legally binding, Migros takes a pioneering position in the Swiss retail market. When conforming to standards that are soon to become legally binding, Migros may develop a lead in terms of expertise and time available to take necessary technological or organizational adjustments. Furthermore, Migros may benefit from greater opportunities to experiment with recently enacted standards in order to achieve the best out of it for the company. Nevertheless, engaging in first-mover initiatives is a costly undertaking for Migros that requires large investments. Consequently, sustainability projects of a considerable size are typically planned carefully some years in advance at Migros. According to Oekom Research, so far only 2500 out of 42,000 big companies in Europe release sustainability reports to the public on a regular basis. Migros expects to be confronted with more and more requirements concerning information transparency and compliance in the near future. So far, promising Swiss customers more than the company would actually have to paid off for Migros.

From the Region. For the Region.

Collaborations with Swiss farmers form the basis of Migros' *From the region. For the region.*-label (FTR). Collaborations of such type strengthen the sustainable character of Migros' private-label products and help the retailer to gain the necessary expertise and innovativeness when expanding into unknown business areas. Thanks to the labels, customers may identify the origin of the designated products more easily. This information transparency strengthens customers' trust in Migros and its products.

One of Migros' many partners is Christian Hauri, milk producer from Seon, Switzerland. His cows predominantly nourish on grass and hay. No

matter, if it is summer or winter, Hauri's cows enjoy freedom of movement on his greenfields. Besides Hauri's strong engagement for the welfare of his cows, he actively supports biodiversity on his grounds to provide endangered plant and animal species a natural habitat. No wonder that Hauri's milk, which is marketed under the labels FTR and *TerraSuisse* at Migros, costs more than the milk purchased at one of the discounters operating in Switzerland. However, a glance at recent sales figures from Migros' regionally produced milk shows that customers seem to value the characteristics of Hauri's milk. Sales generated by FTR-labeled milk increased by one percent between 2013 and 2014. In 2014, sales coming from milk that was produced by FTR-certified farmers like Hauri accounted for 21 percent of Migros total milk sales. In total, Migros collaborates with 7500 Swiss farmers and producers to offer its customers around 8000 products certified with the FTR label (ranging from milk and meat to vegetables and pasta). Total sales generated by FTR products added up to 874 million Swiss francs in 2014. The increase in total sales generated by FTR products between 2013 and 2014 amounted to six percent.

Private-Label Products

Within the last decades, Migros has been evolving from a typical retailer to a vertically integrated company. So far, only a small proportion of companies in the DACH region uses business model innovations to increase sustainability. For example, only 31 percent of managers in Switzerland, Germany, and Austria indicate that they changed their business model because of sustainability actions (IRM 2014). Migros once started by selling standard goods. Since 1929, the company invests heavily to increase its share of goods coming from its own production facilities. Among other things, the increase in private-label products was forced by suppliers not willing to collaborate with Migros because of its low-price strategy. Initially customers were skeptical about this new business concept. Today, they enjoy the Swiss character at affordable prices that Migros' products offer.

By now, Migros industry produces 20,000 food and non-food goods in its 24 production plants. That makes Migros one of the biggest private-label producers around the globe. Migros industry aims to minimize its use of resources, such as water, energy, or raw materials along the entire value chain and strives to enhance the skills of its employees. With these principles in mind, Migros industry intends to secure sustainable economic success in the following decades. The redesign of the *Aproz* bottles is a vivid example of the Migros industry's sustainability initiatives (Fig. 25.4). *Aproz* is Migros' private brand

Fig. 25.4 Aproz bottle before and after the redesign in 2014

for mineral water. In 2014, Migros industry changed the shape of the plastic bottles and designed new labels. At first glance, the change appears to be insignificant, but thanks to this innovation, Migros industry saves 71 tons of packaging material per year without putting the stability of the bottles at risk.

M-way

Apart from the increasing number of private-label products, Migros engages in some other business model innovations that drive sustainability. Since the foundation of the subsidiary m-way in 2010, Migros promotes electromobility in Switzerland. By providing e-bikes, e-scooters, e-motorcycles, and various accessories for electric cars (e.g., charging stations or cables), m-way has become the market leader in the area of electric two-wheelers. To date, customers can visit one of the 28 m-way shops in Switzerland to seek advice about which product fits them best, to borrow one of the two-wheelers or accessories to test them outdoors, to get a service for their electric two-wheeler, or simply to purchase a new product. Furthermore, they may browse through the m-way website to get product information or purchase items conveniently from home.

With m-way Migros has shown that it fosters a mind-set of sustainability, not only within the company and its partnerships but also on the outside—among its customers. M-way draws attention to the harmful manufactured

CO_2 emission. It provides customers with concrete opportunities to reduce their very own share of air pollution. Within the last five years, m-way managed to change the mobility pattern of Swiss consumers. According to an interview with Hans-Jörg Dohrmann (CEO m-way from 2010 until 2017) in 2015, 40 percent of m-way customers bought an e-bike to replace their second car. In line with m-way's constantly growing customer base, its impact on environmental protection in Switzerland increases. In 2014, the company already sold more than 4000 electric vehicles. M-way strongly benefits from first-mover advantages and valuable insights from its customer data analysis. Among other things, these two factors contribute strongly to m-way's encouraging growth figures. During the last five years, the company enjoys sales that double every year.

Sharoo

The latest innovation from Migros is sharoo, an online car-sharing platform that is based on the idea of using existing resources jointly. Founded in May 2014, sharoo provides users with an outlet to lend their own vehicles or rent other peoples' vehicles in exchange for money. Sharoo is designed to help not only individual consumers; firms as well may lend their corporate cars to their employees or the entire sharoo community. The idea of sharing works out well at sharoo. On average, a car is booked for 5.8 hours. Sharoo's customers ordinarily drive 5.5 kilometers per hour with the borrowed cars.

With a platform that exclusively operates in the digital world, Migros uses the powers of the Internet in its quest for sustainability. A large network of users within reach anywhere and anytime, cost savings for store rentals and personnel, bidirectional communication, rich customer data, and the like help Migros to promote the concept of a sharing economy in Switzerland and to increase social and environmental sustainability while increasing competitiveness at the same time. At the beginning of 2015, sharoo's user base increased by 500 individuals per month. By autumn 2015, sharoo already had 18,000 users.

Sharing vehicles that are not needed at that time preserves resources and helps to decrease the number of vehicles registered in Switzerland. Furthermore, sharoo has the power to increase common welfare as it allows people to earn money with their vehicles while it helps others, who cannot afford a vehicle, to increase their mobility. Depending on price and location of the car and on the display duration on sharoo, a user may earn between CHF 50 and CHF 1000 for lending his/her car. Regarding sharoo's effect on Migros, the start-up shall help Migros to enter new business areas and to ensure sustainable growth.

As the Swiss food retail market has reached a maturing phase, investing in new business areas has become a major task for Migros to remain competitive in the future. According to Carmen Spielmann, CEO sharoo, the start-up intends to become an integral part of the Swiss mobility landscape within the next years. It is sharoo's objective to offer sharoo cars on practically every street corner in big Swiss cities in the near future.

Reducing Food Waste

Up to one third of all the food produced across the globe, worth approximately USD 1 trillion (FAO 2014), is thrown away or gets lost in production. Migros has set itself the task to work against this socially and environmentally depressing and simultaneously economically inefficient phenomenon. The company has realized that actions to decrease food waste have to be undertaken along the entire value chain in order to achieve sustainable results.

For Migros' shops and restaurants, thoroughly planned product volumes and delivery times are among the most important initiatives to reduce food waste. Based on their experiences, specialists forecast the required quantities of food needed at Migros' shops and restaurants. Their goal is twofold: reducing the amount of food surpluses in shops and restaurants while offering customers a variety of fresh products shortly before closing time. Migros' products have two expiration dates: the earlier scheduled sell-by date and the later scheduled use-by date. As soon as products reach their sell-by date, Migros donates them to charitable organizations. To minimize the chances that food is wasted, Migros constantly tests which use-by dates can be prolonged (recently the expiry date of 180 types of hard cheese was extended from 32 to 40 days). Furthermore, it sells products that are soon to expire at reduced prices. Products that do not meet the highest quality standards or have minor flaws are sold under the brand *M-Budget*. This enables Migros to offer products for customers with a relatively low income. Additionally, it gives farmers the opportunity to sell not only their A-goods but also their B-goods. Baking stations in the supermarkets enable Migros to offer its customers fresh bread until shortly before closing time while minimizing cost-expensive and unethical over production. To mobilize all employees to work against food waste, Migros defined a comprehensive directive in this matter in 2012.

Apart from demand planning and logistics, production also contributes to the reduction of food waste at Migros. Modern production facilities, carefully trained employees, and well-coordinated processes help Migros to reduce the amount of food that is wasted. To date, 98.6 percent of the food procured by

Migros is sold in its stores and restaurants or is given away to charitable organizations. The remaining food is almost entirely used for pet food, biogas production, and composting so that only 0.1 percent of the food procured by Migros end up in the waste incinerating plant.

Lessons Learned

The Migros case study reveals several success factors of sustainable management. Even though the case study observed and analyzed only one retailer, the portfolio of success factors is applicable to any retailer. The success factors detected within this case study can be classified into organizational, strategic, and operational initiatives. Organizational initiatives strengthening Migros' sustainable management are: (1) integration of sustainability into the corporate vision, (2) strong engagement from all employees, (3) guidance and monitoring by top management, and (4) sustainability team consisting of experienced, senior-level managers from different departments. On the strategic level, the case study identifies five success factors of competitive sustainable management: (1) business model innovations, (2) collaborations with stakeholders, (3) activities along the entire value chain, (4) being first-mover when it comes to meeting standards, and (5) harnessing powers of the Internet. Finally, three operational initiatives were found to influence the outcome of sustainability initiatives: (1) customer engagement, (2) internal and external information transparency, and (3) trying out something new and unconventional. The differences between the three classifications might be blurry, depending on the context of the company. For instance, some retailers might define the success factor customer engagement as an operational initiative, whereas other retailers might classify it as part of their strategy.

The case study on sustainability initiatives at Migros contributes to research and practice in several ways. First, it finds support for success factors of competitive sustainable management mentioned in previous studies and proves their applicability for retailing. Success factors, derived from previous theoretical and empirical work, such as business model innovations, activities along the entire value chain or top management engagement, are also crucial to Migros' success in sustainable management. Since they are constantly in contact with customers, they may react more quickly to their rapidly changing needs and wishes. Thus, customer demands concerning sustainability may be detected and satisfied more successfully among retailers than among other companies. Furthermore, more and more retailers offer customers private-label products. This gives retailers the opportunity to

control sustainability initiatives along the entire value chain. Therefore, the applicability of previously assessed success factors in sustainable management in the retail industry is a promising field of research. Second, the study extends literature on success factors of competitive sustainable management. Success factors such as embedding sustainability into the corporate vision, increasing internal and external information transparency, and harnessing the powers of the Internet could be detected within this study. Third, the study gives insights into the idiosyncrasies of sustainable management in food retailing. Since trust is a decisive factor in food retailing (Rampl et al. 2012), sustainability initiatives in food retailing should be planned and implemented with more diligence than in other industries. Fourth, the study portrays that even well-established retailers constantly need to reinvent their sustainability strategy to stay competitive. The example of Migros illustrates that successful sustainable management requires constant critical reflections on the topic among all employees. Finally, the case study shows how sustainability can help to set off threats coming from changes in the market structure, the competitive environment, and in consumer demands. The sustainable character of Migros' products helps the retailer, among other things, to stand out from traditional and online competitors inside and outside Swiss borders.

Challenges and Barriers

Competition never sleeps. Migros already realized that its sustainability market leadership is not set in stone. Aldi Suisse invests heavily in sustainability. In June 2015, the discounter laid the foundation for its new distribution center in Lucerne. The center is planned to create 80 new jobs and to be among the most sustainable buildings in Switzerland. The other German retailer operating in Switzerland, Lidl, does not want to be perceived as plain hard discounter either. With its recently inaugurated distribution center in Sévaz, Switzerland, Lidl may now abbreviate its transportation routes by more than 1.3 million kilometers and may thus save 1.2 tons of CO_2 emission.

When it comes to regionality of their products, Aldi and Lidl still cannot keep up with the Swiss retailers Migros and Coop. According to the Swiss broadcasting provider SRF, around 75 percent of Migros' and Coop's products come from regional sources (Kohli 2015). Nevertheless, Aldi and Lidl have already increased their share of Swiss products tremendously since they entered the market in 2005 and 2009. According to Georg Kröll, CEO Lidl Suisse, 50 percent of the sales generated in Swiss Lidl stores come from

Swiss products. Developments of this kind demand a high amount of innovativeness at Migros and Coop, especially if the Swiss retailers want to keep one of their biggest benefits, the Swissness of their assortment (Feige et al. 2013).

Looking at the demand side, one can see that more and more consumers think about sustainability when shopping: Where do the products come from? How were they produced and transported? How does one's consumption influence the environment and other people? Equipped with their smartphones, consumers expect to get answers to their questions whenever and wherever they want. Meise et al. (2014) found that consumers value sustainability-related information. Even negative information is valued over no information at all. We already know that value-differentiating attributes may even weigh more strongly than low prices (Meise et al. 2014). Nevertheless, many questions remain open: How much are customers willing to pay more for sustainably produced good? How to best communicate to the customers that the product is sustainable? Do customers from different cultural backgrounds value sustainability differently? Which sustainability initiatives will be basic requirements and which will be true profiling potentials in the future?

Herbert Bolliger, Migros CEO from 2005 until 2017, vividly captures the challenges of sustainability in today's competitive retail landscape. According to him, there is no world formula when it comes to sustainable management. Many small steps along a path with several obstacles characterize sustainability. In his opinion, creative ideas, a learning-by-doing approach, and the strong desire to motivate customers for sustainability are crucial to the success of sustainable management.

Acknowledgments The completion of this case study would not have been possible without the support of others. First, we want to thank the entire Migros team for their guidance and support. We were privileged to work with them. Second, we express our gratitude to the students of the 2016 fall semester class *Supply Chain Management* at the University of St. Gallen. Their feedback on the case study was very helpful to us.

Further Reading

Chkanikova, Olga, and Matthias Lehner. 2015. Private Eco-Brands and Green Market Development: Towards New Forms of Sustainability Governance in the Food Retailing. *Journal of Cleaner Production* 107 (November): 74–84.

Claro, Danny P., Silvio A.L. Neto, and Priscila B.O. Claro. 2013. Sustainability Drivers in Food Retail. *Journal of Retailing and Consumer Services* 20 (May): 365–371.

Dao, Viet, Ian Langella, and Jerry Carbo. 2011. From Green to Sustainability: Information Technology and an Integrated Sustainability Framework. *Journal of Strategic Information Systems* 20 (1): 63–79.

Ougaard, Morten. 2014. Sustainability and Counteracting Factors to Profit Rate Decline. *The European Journal of Social Science Research* 27 (3): 220–237.

Schaltegger, Stefan, and Jacob Hörisch. 2015. In Search of the Dominant Rationale in Sustainability Management: Legitimacy- or Profit-Seeking? *Journal of Business Ethics* 145 (2): 259–276.

Wiese, Anna, Julian Kellner, Britta Lietke, Waldemar Toporowski, and Stephan Zielke. 2012. Sustainability in Retailing–A Summative Content Analysis. *International Journal of Retail & Distribution Management* 40 (4): 318–335.

References

Etsy, Daniel C., and Andrew S. Winston. 2009. *Green to Gold: How Smart Companies Use Environmental Strategy to Innovate, Create Value, and Build Competitive Advantage*. New Jersey: John Wiley & Sons.

FAO. 2014. Food Wastage Footprint: Full-Cost Accounting. http://www.fao.org/3/a-i3991e.pdf. Accessed 10 Oct 2015.

Feige, Stephan, Peter Fischer, Dominique von Matt, and Sven Reinecke. 2013. *Swissness Worldwide 2013–Image und internationaler Mehrwert der Marke Schweiz*. St.Gallen: Thexis.

IRM. 2014. *Unveröffentlichte Managementbefragung zu Nachhaltiger Unternehmensführung*. St.Gallen: Forschungszentrum für Handelsmanagement Universität St.Gallen.

Kiron, David, Nina Kruschwitz, Martin Reeves, and Eugene Goh. 2013. The Benefits of Sustainability-Driven Innovation. *MIT Sloan Management Review* 54 (2): 68–74.

Kohli, Andreas. 2015. Lidls Lehrjahre. Schweizer Rundfunk und Fernsehen, 22 June. http://www.srf.ch/news/wirtschaft/lidls-lehrjahre. Accessed 11 Sep 2015.

Meise, Jan N., Thomas Rudolph, Peter Kenning, and Diane Phillips. 2014. Feed Them Facts: Value Perceptions and Consumer Use of Sustainability-Related Product Information. *Journal or Retailing and Consumer Services* 21 (4): 510–519.

Migros. 2015. Generation M: Der aktuelle Stand unserer Versprechen. http://generation-m.migros.ch/mediaObject/GenM/docs-2015/d/Zieluebersicht-Dezember-2015/original/Zieluebersicht-Dezember-2015.pdf. Accessed 30 June 2016.

Nidumolu, Ram, Coimbatore K. Prahald, and Madhavan R. Rangaswami. 2009. Why Sustainability Is Now The Key Driver of Innovation. *Harvard Business Review* 87 (9): 57–64.

Oekom. 2015. Oekom Corporate Responsibility Review 2015. http://www.oekom-research.com/homepage/german/oekom_CR_Review_2015_DE.pdf. Accessed 8 Sep 2015.

Rampl, Linn V., Tim Eberhardt, Reinhard Schütte, and Peter Kenning. 2012. Consumer Trust in Food Retailers: Conceptual Framework and Empirical Evidence. *International Journal of Retail & Distribution Management* 40 (4): 254–272.

Rudolph, Thomas, Melanie Bassett, and Max Weber. 2015a. *Konsumententrends im SchweizerLebensmitteldetailhandel*. St.Gallen: Forschungszentrum für Handelsmanagement niversität St.Gallen.

Rudolph, Thomas, Liane Nagengast, and Frauke Nitsch. 2015b. *Einkaufstourismus Schweiz 2015*. St.Gallen: Forschungszentrum für Handelsmanagement Universität St.Gallen.

Sheth, Jagdish N., Nirmal K. Sethia, and Shanti Srinivas. 2010. Mindful Consumption: A Customer Centric Approach to Sustainability. *Journal of the Academy of Marketing Science* 39 (1): 21–39.

Universum Global. 2016. Switzerland's Most Attractive Employers 2016. http://universumglobaREFSl.com/rankings/switzerland/student/2016/business-commerce/. Accessed 21 June 2016.

26

Environmental Purchasing in the City of Phoenix

Nicole Darnall, Lily Hsueh, Justin M. Stritch, and Stuart Bretchneider

Background

While the US federal government withdrew from the Paris Climate Agreement, more than 391 US mayors have committed to upholding the Agreement's commitments to reduce greenhouse gases (US Climate Mayors 2018). One way some cities are fulfilling their commitments is through purchasing.

US cities purchase US$1.72 trillion of goods and services annually (US Census 2016), accounting for between 25 percent and 40 percent of every state and local tax dollar spent (Coggburn 2003). Purchased items include chemicals, electronics, furnishings, and office materials, which all contribute to global climate change and other environmental concerns during their production and use. These purchases together create a carbon footprint nine times that of buildings and vehicle fleets (US General Services Administration 2014).

To mitigate these environmental impacts, some local governments have implemented environmental purchasing policies (EPPs). Also known as "environmentally sustainable purchasing policies" or "green purchasing policies," EPPs help minimize cities' environmental impacts by reducing energy use, conserving water, and decreasing the frequency of certain purchases. They can also lead to cost savings while helping cities establish themselves as environmental leaders.

Because of their large purchasing power, cities' eco-friendly purchases have the potential to stimulate the global production of green products and services

N. Darnall (✉) • L. Hsueh • J. M. Stritch • S. Bretchneider
Arizona State University, Phoenix, AZ, USA

R. Brinkmann, S. J. Garren (eds.), *The Palgrave Handbook of Sustainability*,
https://doi.org/10.1007/978-3-319-71389-2_26

(United Nations Environmental Programme 2012; Li and Geiser 2005). They also can create significant market incentives for companies to reconsider their existing production processes, incorporate environmental principles into their daily business routines, and reduce their environmental impacts (Case 2004). By local governments encouraging their suppliers to produce and deliver greener products and services, an estimated 40 percent of these companies will, in turn, assess the environmental activities of the organizations that supply them (Arimura et al. 2011). Cities' eco-friendly purchases, therefore, have the potential to create spillover benefits that extend up the supply chain and across the globe, leading to significant environmental benefits.

However, most US cities have not adopted an EPP (Darnall et al. 2017). Cities that have an EPP often struggle to implement them fully (Darnall et al. 2017). As a consequence, many cities—large and small—have not realized the full potential of their EPPs toward mitigating their environmental impacts. Moreover, markets have been slow to develop green products and services. These are significant concerns that the United Nations Environmental Programme, the International City/County Management Association, the Sustainable Purchasing Leadership Council, and others have suggested must be resolved if we are to move toward an environmentally sustainable economy.

Case Study: The City of Phoenix

One example of a large US city that has experienced several challenges implementing its EPP is the City of Phoenix, the state capital of Arizona. The fifth largest city in the USA with approximately 1,615,017 residents in 2016 (US Census 2017a), the City of Phoenix is situated in the USA's 12th largest metropolitan area (US Census 2017b). Between 2010 and 2015, its population increased by 32 percent (US Census 2017b). The area's above-average growth is expected to continue (Forbes 2015), with an increase of 2.2 million residents by 2030 (World Population Review 2017) and a doubling of its population by 2050 (City of Phoenix 2014). All these factors will increase demands on infrastructure and generate greenhouse gases.

Against this backdrop, and in the last ten years, the City of Phoenix has experienced increases in recorded weather events, such as drought, temperature increases, and heat waves (US Climate Change Science Program 2008). Rapid urbanization has extended the urban heat island effect over larger areas and longer seasons, raising nighttime temperatures by as much as 10 °F

compared to adjoining natural areas (Wittlinger 2011). These quality of life factors affect businesses' decisions to locate or expand their operations in the area (City of Phoenix 2014).

Responding to these concerns, in 2016, the Phoenix City Council approved the "Phoenix 2050 Environmental Sustainability Goals." The goals consist of seven ambitious sustainability targets and one long-term ambition of becoming carbon neutral by operating on 100 percent clean energy (City of Phoenix 2017a). Phoenix 2050 articulates the community's desire to become a "Sustainability Desert City" (City of Phoenix 2017a).

The City's Chief Sustainability Officer and the City's Administrator of the Office Environmental Programs (OEP) believed that having a strong EPP would be critical to meeting Phoenix's 2050 sustainability goals. City of Phoenix leaders also agreed that environmental purchasing could save taxpayers' money. As an example, the City's Office of Sustainability determined that if the City purchased 100,000 energy-efficient streetlights and replaced its existing inefficient bulbs, it could cut carbon emissions by up to 60 percent (City of Phoenix 2017c). The purchase was also estimated to save taxpayers up to US$22 million through 2030 due to energy savings and reduced maintenance costs (City of Phoenix 2017b).

Environmental Purchasing

The City's interest in eco-friendly purchasing took root in 2007 when the Phoenix City Council passed Resolution 20519. The resolution granted authority to the City of Phoenix to develop an EPP that:

1. Integrated contract provisions for sustainable products and services, where the contract provisions were updated as necessary to address changes in technologies or changes in environmental conditions.
2. Considered the purchase of products and services that achieved the best value, which consisted of price, performance, and environmental characteristics over the life cycle of a product or service.
3. Supported manufacturers and vendors whose services, production, and distribution systems reduced environmental and human health impacts.
4. Encouraged buyers and consumers to adopt similar policies and programs (City of Phoenix 2007).

The City of Phoenix developed its EPP in 2012 (City of Phoenix 2012), although by 2016, it had not been implemented fully. The challenge facing

the City of Phoenix (and many other US cities) was how to integrate its EPP into its existing organizational structure and purchasing systems given decreasing budgets and greater focus within departments on low-cost purchases.

Additionally, purchasing within the City of Phoenix was not centralized within a single department but decentralized within individual departments. While each department had similar core purchasing procedures, there was significant variation regarding the types of purchases made (e.g., routine vs. non-routine, low cost vs. high cost). Departments also varied in the autonomy they granted to purchasing officers, in addition to purchasing officers' level of specialization and training.

While these issues complicated EPP implementation, the City of Phoenix's OEP Administrator believed that implementing the City's EPP was important. He was open to innovative approaches that might assist in the implementation of the City's EPP. This setting led to a partnership between OEP and the Center for Organization Research and Design (CORD), a research center at Arizona State University (ASU) that promotes, supports, and conducts fundamental research on public, nonprofit, and hybrid organizations and their design.

The City of Phoenix/CORD partnership had two goals:

1. Determine which factors impede and facilitate EPP implementation within the City of Phoenix.
2. Develop recommendations for how the City of Phoenix could improve EPP implementation.

Research Approach

To achieve its partnership goals, in cooperation with the City of Phoenix, CORD researchers completed a series of focus groups with City purchasing employees. The focus groups allowed for the collection of qualitative data in a setting that was dynamic and user-driven (Merton et al. 1956). They provided a "safe" environment for purchasing employees to discuss the City's EPP. CORD used a semi-structured interview to leverage the group context and create interaction among interviewees. This approach was particularly important given the complexity of purchasing within the City and the lack of information regarding how purchasing employees integrated environmental considerations into their existing purchasing procedures.

CORD identified focus group participants with the assistance of OEP and interviewed 14 Phoenix purchasing employees (across five different departments). The City assembled participants into three focus groups. The first

group consisted of purchasing employees within the Finance Department and the Deputy Director of Finance. The second and third groups included a combination of purchasing employees within the Water Services Department, Public Works, Aviation, and the Convention Center.

Each focus group session lasted between 75 and 90 minutes. One CORD researcher served as the focus group facilitator. This individual ran each session and asked the same interview questions to each focus group. Three other CORD researchers took notes. The notes' content was analyzed and assessed for the presence of major themes. Content analysis was the preferred analytical method because of its higher level of rigor and lower risk of error compared to other types of interview analyses (Krueger and Casey 2001). Since the focus group discussions were not audio recorded, the quotes offered in the sections below may not be verbatim; they represent a paraphrase of the group discussion.

Facilitators of Environmentally Preferred Purchasing

Despite their diverse work settings, the City's purchasing employees were fairly consistent in their identification of the different EPP facilitators. CORD researchers focused on the top five most frequently discussed, which accounted for approximately 96 percent of the themes emerging across all of the focus group sessions (Fig. 26.1). The five facilitators were knowledge about sustainable alternatives, cost-effectiveness and financial incentives, e-procurement system, department culture, and executive-level directives. The percentages associated with each facilitator reflect the proportion of the total comments

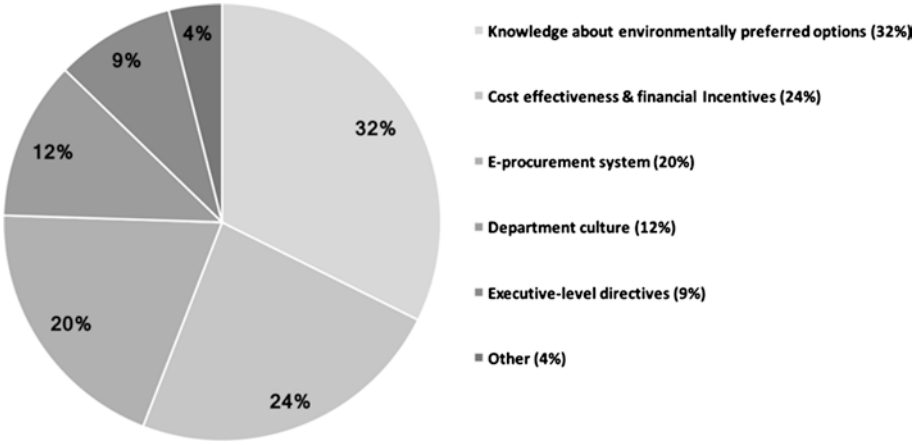


Fig. 26.1 Facilitators of the City of Phoenix's EPP

related to each theme. Across all the facilitators, reducing costs was a unifying concern in that focus group participants often suggested that successful eco-friendly purchases were generally motivated by cost savings.

1. Knowledge of Environmentally Preferred Alternatives (32 Percent)
The most commonly mentioned facilitator for the implementation of the City of Phoenix's EPP was knowledge of environmentally preferred options or alternatives. With limited resources, many focus group participants expressed that they did not have the time or capacity to research eco-friendly alternatives for product requests. However, access to information about these alternatives can have a significant influence on purchasing decisions. Focus group participants also emphasized the need for greater education about environmentally preferred options.

> There are so many options for sustainable products that departments might not be aware of them all. Education and vendor forums might be a good way to distribute information to the departments.

> At all department levels, people do not know what sustainable products are out there, and the product options are continually changing. We are constantly playing catch up.

2. Cost-Effectiveness and Financial Incentives (24 Percent)
The second most widely cited facilitator that focus group participants discussed was cost-effectiveness, including financial incentives (e.g., federal energy rebates). When eco-friendly purchases can generate immediate cost savings, participants state that the transaction is more likely to take place. Focus group participants noted that the City of Phoenix's 2050 goals include significant waste-reduction measures that are motivated by cost reductions. Environmental impact reductions are often secondary concerns.

> The City has an efficiency initiative that will drive change. For example, the City eliminated all desktop printers. Printing now occurs from centralized department printers. The change has caused staff to print less and we have fewer orders for cartridges, printers, and paper. All of this has helped control costs.

> Initiatives that are most successful are the ones where the City saves money.

> The City generates a lot of waste. Eco-friendly purchases that are regarded as more successful reduce environmental impacts by creating opportunities to sell the waste they generate to vendors who take it away and recycle it.

Likewise, focus group participants reported EPP implementation is facilitated by financial incentives, such as federal or state rebate programs for energy and water conservation. Some participants stated that they pursue purchases that conserve energy primarily to obtain government rebates, thus saving the City money. The fact that these purchases are also eco-friendly is a secondary benefit.

> We are reducing energy usage. If the electric utility has a rebate program, we have a designated energy purchaser to look at it to see if the City can qualify and save additional resources.

3. E-Procurement System (20 Percent)

Focus group participants mentioned the City of Phoenix's new e-procurement system as a potential facilitator for implementing the City's EPP. They believed that e-procurement could be leveraged as a cataloging tool that centralizes transaction records about eco-friendly products, thus allowing the city to track its environmentally preferable purchasing activities. Participants also mentioned that coupling the e-procurement system with information about eco-labeled products could further facilitate EPP implementation because it would reduce the effort required to identify environmentally preferred products. While the City's e-procurement system had this capability, it was not being used in this way. Participants cited a lack of training as the main reason the system has not yet been leveraged to promote environmentally preferred purchasing.

> I think the e-procurement has the capability to allow you to track green purchases, but I am not sure it is currently being used in this way.

> Our whole contracting process is new. Understanding it involves a steep learning curve. Eventually there should be sustainable purchasing catalogs. Environmental specifications should be included or tracked in the request for proposal (RFP) process.

4. Department Culture (12 Percent)

The fourth most cited facilitator that focus group participants mentioned was the role of management to elevate environmental concerns as a priority within their department. Participants emphasized the importance of top management in establishing a department culture where employees are expected to implement the City's EPP.

> Management has to take the lead and set the tone. This will help make the program successful.

> Other than encouraging water conservation—sustainability is not discouraged, but it is also not actively encouraged.

> Getting users on board would facilitate environmental purchasing. The general mentality is that people want to purchase goods fast and cost effectively. Purchasing employees need to learn more about green purchasing options. However, these same people tend to want to get things done and identifying these options takes time and comes with tradeoffs that are not always supported at a higher level. Department managers need to prioritize it.

5. Executive-Level Directives (Nine Percent)

Executive mandates or purchasing directives from the City Mayor or City Council were also discussed as important motivators for implementing the City of Phoenix's EPP. At the department level, purchasing employees agreed that while cost is the immediate concern, departments will prioritize directives coming from executive mandates. For example, the City has a mayoral directive that gives preference for purchases from small business enterprises. Even if other bids are more competitive in terms of cost, purchasing professionals must first confirm that small business enterprises are unable to provide the same product or service. Focus group participants indicated that having a similar directive for environmental purchasing would help facilitate EPP implementation.

> Environmental purchasing needs authority from the council and mayor. It needs power like the City's Office of Local Small Business Enterprises.

> Purchasing employees can't tell their departments what to do. To implement EPP across departments we have to get direction from department leadership or the mayor.

While City Council passed a resolution for the City's EPP in 2007, many of the City's purchasing professionals were not employed by the City at the time. Purchasing employees noted that reaffirmation of the City Council's support for the City's EPP would help facilitate implementation.

> We need the EPP to be backed by City Council. It needs to state that this is a priority.

Challenges and Barriers of EPP Implementation

In addition to identifying factors that would facilitate EPP implementation, the focus group discussions revealed that the City had five significant challenges/barriers to implementing its EPP, which accounted for approximately 97 percent of the themes emerging across all of the focus group sessions (Fig. 26.2). Cost was an overarching concern across all barriers.

1. Purchasing Management Structure (26 Percent)
The focus group participants identified that the top barrier to implementing Phoenix's EPP was the complexity and variation in how purchasing was managed by the different departments. Some larger departments had nearly autonomous purchasing units, while other departments' purchasing procedures were managed through the Finance Department. Focus group participants suggested that these variations presented a significant barrier to integrating the City's EPP across departments because they create inconsistencies across department practices.

> The City's departments are generally siloed, which creates a lot of variation in how departments operate. The Aviation Department might go about purchasing in a way that is completely different from other departments. Smaller departments might get support from the Finance Department, but they still do their own thing. At a higher level, there is a lot of push for purchasing to use negotiated city-wide contracts.

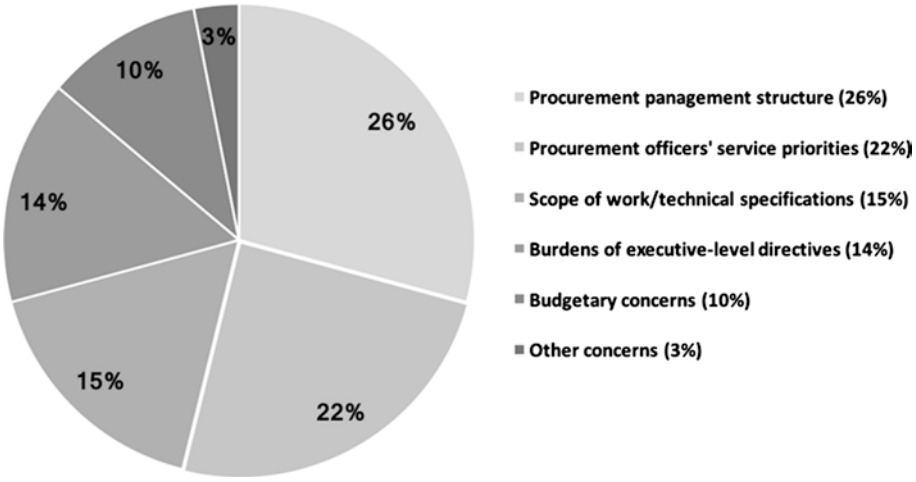


Fig. 26.2 Barriers to implementing the City of Phoenix's EPP

> In the Public Works Department, internal purchasing personnel support all the purchasing needs for our department, facilities, fleet management, and solid waste. For purchases above $50,000, we cooperate with the Finance Department to award most contracts. However, all purchases below $50,000 are handled at the department level.

> Our department is affected by negotiated city-wide purchases. Central purchasing manages these transactions, and they reach out to the other departments for feedback prior to making the purchase. However, for these purchases to be successful, each department has to agree on the product or service. The process of reaching agreement makes it difficult to purchase anything—let alone anything sustainable.

Another barrier in the City's purchasing management structure was related to coordination between OEP and the other departments, which reduced the influence of the City's EPP. OEP acted as an environmental policy advisor for the City. While OEP provided departments information on environmentally preferred products, it lacked authority to require EPP implementation. Additionally, OEP was not always included in strategic discussions at a higher level, which might lead to further EPP integration and the creation of incentives that would encourage City departments to purchase greener products.

> OEP needs to be on the City's strategic team for the implementation of strategic purchasing. It needs more leverage at a higher level.

> OEP needs to be included on the City's strategic team.

2. Purchasing Employees' Service Priorities (22 Percent)

The second most cited barrier to EPP implementation was the service priorities of the City's purchasing employees. Purchasing employees felt constrained to implement the City's EPP because of their belief that environmentally preferred options generally cost more in the short term, which conflicts with their limited operating budgets. Additionally, they felt restrained by their internal clients' need for expedient purchases because they report that it takes time to search for and identify eco-friendly products' alternatives.

> The challenge that purchasing employees face is that we are often reacting to the immediate needs of departments…. We are trying to execute a purchase quickly and don't have time to search for alternatives.

> I am working on the client side of the purchasing. I try to figure out what the end user needs. I try to get the best price and best service. I help clients do the research—I keep an eye on performance, quality, and price.

> We execute 1,500–2,000 contracts, 400 formal purchases per year. Our responsibility is to serve the departments by getting them what they need quickly, by complying with the law, and saving money for taxpayers.

3. Scope of Work/Technical Specifications (15 Percent)

Focus group participants identified that the third significant barrier to EPP implementation was the scope of work/technical specifications in their RFPs and contracts. A priority for purchasing employees was to meet the specifications and demands of the bid. According to focus group participants, environmentally preferred products often have to meet a higher bar. That is, eco-friendly products and services must be cost-effective and meet or (more often) surpass the performance of the contract's technical specifications. Generally, these technical specifications focus on product performance and have little to do with environmental impact.

> I think the biggest priority for my work is to fulfil the expectations of the end user. Some environmentally preferred products do not work as well as conventional products. Sometimes the user will try a product and it just does not work. We have to get products that meet the end-user's needs.

> It depends on the purchase. In custodial services, we can write technical specifications that require the use of products that have lower environmental impact. However, customer cost and need matter.

> One instance where it was better to go with a recycled product was with recycled toner cartridges. Departments pushed for recycled toner cartridges in their technical specifications because these cartridges performed as well as non-recycled cartridges and were cheaper.

4. Burdens of Executive-Level Directives (14 Percent)

The fourth barrier was related to the idea that while the directives at the executive level (mayor, city manager, city council) can serve as facilitators of EPP, they were problematic because they might have competed with other mandates, such as the Local Small Business Enterprise Program, which prioritizes small businesses in contracting. Competition arises because small businesses may not have the capacity to offer environmentally preferred product options. Focus group participants also worried that executive mandates for environmental purchasing might have unnecessarily constrained departments.

> Environmental purchasing might negatively affect the mayor's Local Small Business Enterprise Program because local/small businesses may not get green products at low prices.

> City-wide initiatives of all sorts are a challenge. The airport needs 24-hour operation—this creates different organizational needs. The airport might need different vendors that meet federal safety requirements. Also, the airport has different insurance requirements from vendors.

5. Budgetary Concerns (10 Percent)

The final barrier that focus group participants discussed was related to budgetary concerns. Department budgets had not been structured to consider life-cycle costs of purchases. These costs included avoiding risk to human health, disposal costs after a product is used, and energy savings that accrue over time. Rather, the City's budgeting process emphasized the immediate cost of a good or service. Participants acknowledged that this posed a significant obstacle to implementing the City's EPP, since many eco-friendly purchases could be justified if considering the life-cycle costs of a product.

> In the context of lightbulbs, some people would rather pay more over the long run for inefficient lightbulbs. Our users are educated enough to see the value—but at the end of the day, they would rather have the nickel today than a dime tomorrow.

> When we are trying to switch to green products, we have to consider budget. Initial cost drives most decisions.

> Department directors look at the rest of the year's budget at three months. If the revenues aren't coming in as they had anticipated, they begin looking at how to cut the budget. When this happens, no one is going to buy the more expensive LED lightbulb even if it saves money in the future.

> While the city encourages us to purchase environmental friendly products, the challenge has been cost—departments have to balance budgets against sustainability.

Lessons Learned

In sum, the City of Phoenix focus group participants suggested that five factors had the potential to facilitate the City's implementation of its EPP:

1. Knowledge of environmentally preferred alternatives
2. Cost-effectiveness and financial incentives

3. E-procurement system
4. Department culture
5. Executive-level directives

However, multiple barriers existed that prevented further implementation:

1. Purchasing management structure
2. Purchasing officers' service priorities
3. Scope of work/technical specifications
4. Burdens of executive-level directives
5. Budgetary concerns

Recommendations

Drawing on these findings, CORD researchers offered eight cross-departmental and city-level recommendations to help the City of Phoenix more fully integrate its EPP into existing purchasing processes.

Recommendations at the department level included:

1. Reinvigorate the City's EPP Team

While the City had an "EPP team" consisting of purchasing professionals across departments and personnel from the Phoenix's OEP, it was not active. The City should reinvigorate this team to harmonize purchasing practices and reduce inconsistencies across departments. The EPP team should work with personnel to negotiate citywide purchases to ensure that contracting mandates are, to every extent possible, linked with budget adjustments at the department level. Further, the EPP team is advised to ensure that citywide purchases consider environmentally preferred alternatives.

2. Network to Share Best Practices

The EPP team and Phoenix's OEP should strengthen networks to share best practices. Professional networks such as the International Green Purchasing Network, Responsible Purchasing Network, and Sustainable Purchasing Leadership Council support green purchasing across all types of organizations. They help members share best practices. Participating in these networks can assist the Phoenix's EPP team and OEP programs learn additional ways to integrate environmental purchasing into existing routines and processes, to identify innovative solutions around green purchasing, and to enhance vendor

relations. These networks can also inform the City of external support, such as grants, educational programs, and awards/recognitions that can assist with EPP implementation.

3. Broaden Representation on the City's Strategic Purchasing Team
The City's team for strategic purchasing should be broadened to include the OEP Administrator. Doing so would ensure that environmentally preferred purchasing is considered in strategic purchasing city wide. Representation would also provide important feedback to OEP with respect to issues which need addressing in order to further integrate environmental considerations into the purchasing process.

4. Implement EPP Training
The City of Phoenix's OEP should coordinate with other departments to offer internal training on environmentally preferred purchasing. Training should be offered to purchasing employees. They should cover how scopes of work/technical specifications can be broadened to include environmentally preferred products, how purchasing employees can access information about environmentally preferred alternatives, and how life-cycle costs should be considered when developing technical specifications.

5. Integrate Eco-Label Information into E-procurement
The US Environmental Protection Agency (USEPA) has identified a list of most preferred ecolabels to facilitate eco-friendly purchases within government (USEPA 2017). This list is based on an independent assessment of private sector environmental performance standards and ecolabels using the EPA Guidelines for Environmental Performance Standards and Ecolabels (USEPA 2017). The City of Phoenix should link its e-procurement system with this list so that purchasing employees can more easily identify which products are more environmentally friendly than others.

6. Expand Life-Cycle Costing
OEP should expand its life-cycle costing (LCC) of products and link these costs to departmental budgets whenever possible. LCC is a process of reviewing and evaluating the environmental costs of a product throughout the product's entire life cycle—from "cradle to cradle" (USEPA 2006). For example, energy-efficient appliances can be more expensive at the initial point of purchase but will save energy (and money) throughout the appliances' working life. LCC can help identify products that comply with technical specifications and have the lowest total cost. Moreover, using LCC is consistent with the

City's EPP guidelines to remain fiscally responsible and can provide the business case to departments about the value associated with purchasing more environmentally friendly products and services.

Recommendations for change at the city level include:

7. Develop an Executive Directive for Environmentally Preferred Purchasing

The City should develop an executive-level directive on environmentally preferred purchasing similar to its Local Small Business Enterprise directive. This directive should include a reserve contract program, where selected goods and services are reserved for competition only among eco-friendly products that demonstrate significant reductions in life-cycle costs. A mandate at the executive level would foster a stronger departmental culture around EPP, as well as encourage greater innovation and movement at the department level around green purchasing.

8. Create Incentives for EPP Implementation

The final recommendation is that the City should create incentives across all departments for implementing its EPP. Doing so would help create a culture that encourages creativity and rewards eco-friendly purchasing. These incentives should be made in conjunction with the EPP Team and include recognitions for units (or individuals) that use LCC to reduce long-run purchasing costs. Since initial purchase costs take priority for most city purchases, departments should be granted latitude to purchase goods and general services that may extend beyond the immediate budget constraints but will save the City significant resources over time. Other incentives include competitions among departments or across purchasing categories to reduce life-cycle costs of purchases.

Epilogue

In February 2017, CORD researchers presented their recommendations to the City of Phoenix Administrator of OEP and the City's Deputy Finance Director. The partnership between the City and ASU helped build momentum around implementing the City's EPP by engaging critical stakeholders in the purchasing process. In March 2017, the OEP Administrator stated:

> Phoenix will use the feedback to improve the City's sustainable purchasing program and advance the City's 2050 environmental sustainability goals. The research…will help [us] develop a holistic program that engages the City's buyers to increase green purchasing. (Newberry 2017)

Since the partnership's completion, several other changes have occurred. The focus group discussions helped OEP identify the extent to which the City's purchasing employees believed that eco-friendly products cost more than traditional products. In response, OEP has enhanced its LCC to show City of Phoenix departments that purchasing eco-friendly products can reduce costs over the life cycle of the product (Faller 2017). Additionally, OEP has continued to modify the City's e-procurement system to make it easier to buy environmentally preferable products (Faller 2017).

In summer 2017, the City began to revise its EPP to provide more guidance to City of Phoenix purchasing employees so that eco-friendly purchasing can be executed more easily. As part of this revision, OEP began to broaden its EPP to include the social aspects of purchasing in a new "Sustainable Purchasing Policy" (SPP). The City's evolving SPP incorporates several purchasing programs that previously existed outside of OEP, such as the City's focus on purchasing from minority-owned businesses, women-owned businesses, and locally owned businesses. All these efforts will help the City meet its Phoenix 2050 sustainability goals and its more recent commitment to uphold the provisions of the Paris Climate Accord (Gardiner 2017).

Acknowledgments The authors thank the City of Phoenix for the opportunity to undertake this research and the V. Kann Rasmussen Foundation for its financial support.

Further Reading

Darnall N, Stritch JM, Bretschneider S, Hsueh L, Duscha M, Iles J, No W, Suarez J, Burwell C. 2017. *Advancing Green Purchasing in Local Governments*. Phoenix: Arizona State University, Center for Organization Research and Design, Sustainable Purchasing Research Initiative.

Darnall N, Stritch JM, Bretschneider S, Hsueh L, and No W. 2017. Going Green on Purchasing: Eight Practices to Reduce Environmental Impacts. *Public Management Magazine* 27 (August): 28–29.

Gardiner, D. 2017. Mayor Greg Stanton: Despite U.S. Withdrawal, Phoenix Will Support Paris Climate Pact. AZ Central, June 1. azcentral.com/story/news/local/phoenix/2017/06/02/mayor-greg-stanton-despite-u-s-withdrawal-phoenix-support-paris-climate-pact/363450001/. Last accessed 5 Sept 2017.

References

Arimura, T.H., N. Darnall, and H. Katayama. 2011. A Gateway to More Advanced Voluntary Action? The Case of Green Supply Chain Management. *Journal of Environmental Economics and Management* 61 (2): 170–182.

Case S. 2004. Policy Updates Inspire Environmental Purchasing. *American City & County*. Accessed 13 Feb 2014.

City of Phoenix. 2007. *Resolution 20519. A Resolution of the City of Phoenix on Environmentally Preferable Purchasing*. https://www.phoenix.gov/oepsite/Documents/031916.pdf. Accessed 26 Jan 2018.

———. 2012. *Phoenix EPP Policy*. https://www.phoenix.gov/oepsite/Documents/070520.pdf. Accessed 26 Jan 2018.

———. 2014. *Development of 2050 Sustainability Goals and Targets. Environmental Quality Commission*. November 20. https://www.phoenix.gov/oepsite/Documents/Sustainability%202050%20Goals%20Presentation%20%2011.20.14.pdf. Accessed 26 Jan 2018.

———. 2017a. *Environmental Sustainability Goals*. https://www.phoenix.gov/sustainability. Accessed 26 Jan 2018.

———. 2017b. *Initial Phase for LED Street Light Conversion Work Begins August 14*. https://www.phoenix.gov/news/streets/1786. Accessed 26 Jan 2018.

———. 2017c. *LED Streetlight Program*. https://www.phoenix.gov/streets/neighborhood-matters/street-light-information/led. Accessed 26 Jan 2018.

Coggburn, J.D. 2003. Exploring Differences in the American States' Procurement Practices. *Journal of Public Procurement* 3 (1): 3–28.

Darnall, N., J.M. Stritch, S. Bretschneider, L. Hsueh, M. Duscha, J. Iles, W. No, J. Suarez, and C. Burwell. 2017. *Advancing Green Purchasing in Local Governments*. Phoenix: Arizona State University, Center for Organization Research and Design, Sustainable Purchasing Research Initiative.

Faller, M.B. 2017. ASU Initiative Helping Cities to Become More Sustainable. *ASU Now*, 6 July. https://asunow.asu.edu/20170705-arizona-impact-asu-initiative-helping-cities-become-more-sustainable. Accessed 26 Jan 2018.

Forbes. 2015. *America's Fastest Growing Cities in 2015*. https://www.forbes.com/pictures/emeg45eegeg/11-phoenix-ariz-3/#1dfdd43f15b7. Accessed 26 Jan 2018.

Gardiner, D. 2017. Mayor Greg Stanton: Despite U.S. Withdrawal, Phoenix Will Support Paris Climate Pact. AZ Central, June 1. www.azcentral.com/story/news/local/phoenix/2017/06/02/mayor-greg-stanton-despite-u-s-withdrawal-phoenix-support-paris-climate-pact/363450001/. Last Accessed 26 Jan 2018.

Krueger, Richard E. and Casey, Mary. Designing and Conducting Focus Group Interviews. *Social Analysis: Selected Tools and Techniques*. World Bank, Social Development Papers. Paper Number 36: (2001). pp. 4-23.

Li, L., and K. Geiser. 2005. Environmentally Responsible Public Procurement (ERPP) and Its Implications for Integrated Product Policy (IPP). *Journal of Cleaner Production* 13: 705–715.

Merton, Robert K., Marjorie Fiske, and Patricia L. Kendall. 1956. *The Focused Interview*. Glencoe: The Free Press.

Newberry, B. 2017. ASU Research Informs City of Phoenix on Eco-friendly Buying. *ASU Now*, 3 March. https://www.asunow.asu.edu/20170303-asu-research-informs-city-phoenix-eco-friendly-buying. Accessed 26 Jan 2018.

US Census Bureau. 2016. *State and Local Government Finances by Level of Government and by State: 2013–2014*. https://www2.census.gov/govs/local/14slsstab1a.xls. Accessed 26 Jan 2018.

US Census. 2017a. Community Facts. Selected: Philadelphia City, Pennsylvania; Phoenix City, Arizona; Houston City, Texas; Chicago City, Illinois; Los Angeles City, California; New York City, New York. https://www.census.gov/quickfacts/fact/table/philadelphiacitypennsylvania,phoenixcityarizona,houstoncitytexas,chicagocityillinois,losangelescitycalifornia,newyorkcitynewyork/PST045216. Accessed 26 Jan 2018.

———. *Community Facts*. Estimates of Resident Population Change and Rankings: July 1, 2015 to July 1, 2016. 2017b.

US Climate Change Science Program. 2008. In *Weather and Climate Extremes in a Changing Climate*, ed. T.R. Karl et al. Washington, DC: Department of Commerce, NOAA's National Climatic Data Center.

US Climate Mayors. 2018. *391 US Climate Mayors Commit to Adopt, Honor and Uphold Paris Climate Agreement goals*. https://medium.com/@ClimateMayors/climate-mayors-commit-to-adopt-honor-and-uphold-paris-climate-agreement-goals-ba566e260097. Accessed 26 Jan 2018.

US Environmental Protection Agency (USEPA). 2006. *Life Cycle Assessment: Principles and Practice*. Washington, DC: USEPA, National Risk Management Research Laboratory, Office of Research and Development.

———. 2017. *EPA's Recommendations of Specifications, Standards, and Ecolabels for Federal Purchasing*. https://www.epa.gov/greenerproducts/epas-recommendations-specifications-standards-and-ecolabels-federal-purchasing. Accessed 26 Jan 2018.

US General Services Administration. 2014. *Remarks by GSA Administrator Dan Tangherlini at SPLC's 2014 Summit*. https://www.sustainablepurchasing.org/blog/2014/05/24/remarks-by-gsa-administrator-dan-tangherlini-at-splcs-2014-summit/. Accessed 26 Jan 2018.

United Nations Environmental Programme. 2012. *The Impacts of Sustainable Public Procurement: Eight Illustrative Case Studies*. Paris: United Nations Environmental Programme.

Wittlinger, S. 2011. The Urban Heat Island: Jeopardizing the Sustainability of Phoenix. *Policy Points* 3 (3): 1–3.

World Population Review. 2017. Phoenix Population 2017. www.worldpopulation-review.com/us-cities/phoenix-population/. Accessed 26 Jan 2018.

27

The Dual Promise of Green Jobs: Sustainability and Economic Equity

Ellen Scully-Russ

Background

The unparalleled public investment in the development of new green products and industries to feed new economic markets has given rise to calls for a broader policy and ethical framework to collectively plan, manage, and evaluate these investments. Indeed, Pinderhughes (2007) and others (Jones 2008; Renner et al. 2008; Speth 2010; Ehresman and Okereke 2015; Smit and Musango 2015) suggested that the emerging green economy offers a historic opportunity to rethink the basic purposes, relationships, ethics, structures, policies, and practices that constitute the US political economy and the twenty-first-century labor market. Jones (2008) called for a New Green Deal to drive policies leading to a sustainable economy and good jobs that ensure economic justice for all workers and communities. These advocates have suggested that the greening of the economy offers a dual promise to protect the environment and provide decent work for all.

The social opportunity of a green economy lies in the emergent character of green jobs because the structure, nature, and scope of this new labor market are malleable and open to influence from a variety of interests and stakeholders. Consequently, some analysts (Pinderhughes 2007; Jones 2008) have argued that green jobs offer a rare opportunity to leverage public investments

E. Scully-Russ (✉)
Associate Professor and Director of the Executive Leadership Doctoral Program, The George Washington University, Washington, DC, USA

R. Brinkmann, S. J. Garren (eds.), *The Palgrave Handbook of Sustainability*,
https://doi.org/10.1007/978-3-319-71389-2_27

to improve the nature of work and economic opportunity in the labor market, yet there is limited empirical evidence to support this claim.

This chapter reports on a case study that explored the impact of two training programs on the labor market institutional framework in their regions. One research question motivated this study: did the leaders and participants in two publicly funded green jobs training programs (GJTPs) leverage federal job training funds to create good jobs and improve the functioning of the labor market institutions in the region, and if so, how?

Conceptual Framework

This study is situated in concerns for mounting risk in society. Concerns for mounting risk and growing inequalities underlie both the sustainability and labor market literature. Climate change researchers, for example, are concerned with the enormous risk associated with the increased frequency and severity of natural disasters (Pachauri et al. 2014). These occurrences profoundly affect access to natural resources, food production, settlement patterns, and population mobility that can expose people to great risk, in part because they also exacerbate deep social injustices (Hartman and Squires 2006). Likewise, labor market researchers (Schmid 2006; Kelleberg 2011) have noted that work and careers are risky propositions in the twenty-first-century labor market. For example, workers face the risk of exclusion due to failures in education and training (Schmid 2006); the risk of precariousness associated with the rise of contingent work arrangements (Schmid 2006); and the risk of long-term unemployment due to the erosion of internal labor market structures (Schmid 2006). Economists (Kelleberg 2011; Appelbaum 2012) have linked the growing inequality in society to these risk-laden labor market trends.

Ironically, however, much of the public debate about climate change has focused on a perceived conflict between the environment and jobs (Renner et al. 2008). While it is commonly understood that a shift to a carbon-neutral economy will result in significant job loss in core industries, the long-term employment prospects in so-called green industries and jobs remain unclear (Stone 2010). Yet, green advocates (Korten 2001; Goerner et al. 2008; Speth 2010) have called attention to the link between social inequality and environmental quality. Jones (2008), for example, noted that only a small, elite segment of society can afford to lead eco-friendly lifestyles, while the growing number of people living in poverty cannot. Research (Lipfert 2004) has also shown that poor communities face unequal exposures to pollution and other

environmental hazards. A new green agenda, therefore, must also alter the living conditions of poor communities (Renner et al. 2008). Impoverished communities must be granted full economic participation (Jones 2008).

The debate on green jobs lies at the nexus of the dual calls for a sustainable environment and economic equity. In the wake of the global recession of 2008, the G20 governments invested $2.6 trillion to stimulate economic growth; roughly $400 billion was invested in new clean technologies (Cleantech 2009). The American Recovery and Reinvestment Act of 2009, for example, invested upwards of $110 billion in the emerging green economy. Given the public stake in the green economy, poverty advocates seek to ensure that green jobs are also good jobs that improve the environment while helping to reduce poverty by providing gainful and decent work for the world's poor (Renner et al. 2008).

The challenge, however, is that labor market analysts question whether the US workforce development system is up to the task of supporting the emerging green industry. The public system is both fragmented (Conway and Giloth 2014) and incoherent (Marshall and Plotkin 2010). Some (Curson et al. 2010) have suggested that traditional workforce development strategies lack capacity to respond to the needs of emerging and rapidly changing industries and occupations. An important question for sustainability and labor market research, therefore, is whether the unprecedented public investments in green jobs will result in new institutional capacity to address the mounting risk and growing equality that is of great concern to both sustainability and labor market advocates today.

Figure 27.1 presents the conceptual framework underlying this study. Concerns for the mounting risk and inequality in society in part motivate sustainability and labor market advocates to press for improvements to social

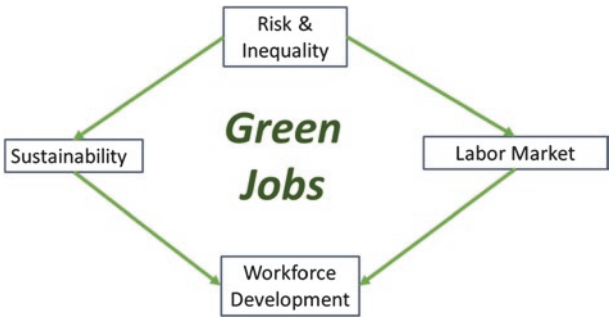


Fig. 27.1 Conceptual framework

policies and infrastructures to bring about innovations in meeting social and environmental needs. In the case of green jobs, the unprecedented public investment in new green industries provides an opportunity to consider ways to improve and modernize workforce development strategies and infrastructure and align them more closely with the needs of emerging and rapidly changing industries and occupations.

Methodology

This was a case study of two recipients of the US Department of Labor's (DOL's) GJTP grant, awarded in 2010. The cases were selected with assistance from DOL staff based on two criteria: (1) the sites were significantly developed to warrant study and (2) the program operators agreed to support the study activities. Ten sites met the criteria. The two sites were selected because together they represented a wide spectrum of green industries and jobs.

Data collection included documentation review of the partnerships' DOL proposal, planning documents, partnership agreements, promotional materials, grant performance reports, curriculum, and other documentation related to the services offered to individuals and firms. In addition, documentation of the regions' emerging green economic sectors and government efforts to support the green economy was reviewed for background on the states' green economic infrastructure. Semi-structured interviews were conducted with the program operators, state workforce development officials, educators, and employers participating in the training program. Interviews focused on the participants' engagement in the partnerships, as well as goals for and perceptions of improvements to the region's green industry and workforce infrastructure. The data were analyzed utilizing the constant comparative method. Each interview was systematically compared with data from other interviews in each peer group (i.e., employers, educators, and workforce development system representative) in each site and then across the two sites.

Case Study Descriptions

A brief discussion of the two GJTPs and their key strategies is followed by a cross-case analysis of stakeholders' perspectives on the implications of the partnerships' activities for green jobs and labor market institutions in the two regions.

Vermont GREEN

Vermont ranks eighth in the nation for percentage of local consumption of locally produced renewable energy, and it is a leader in encouraging and in some cases financing a shift to a carbon-neutral economy. This favorable green policy environment has resulted in the development of new green businesses, as well as the greening of existing industries and jobs.

A 2009 survey of the Vermont environmental business sector found that over half of the 250 respondents expected to grow their environmental business over the next 5 years (Vermont Environmental Consortium 2009). However, one in five employers reported difficulty finding qualified project managers and technicians, and over one-third reported that they had not been able to find training in Vermont that could help them fill these gaps. The two employers interviewed for this study confirmed these findings. Both were preparing to launch new green products and expected to increase their workforce if their new products were successful. However, both expressed concerns over whether the skills they needed to move into these markets were widely available in the workforce.

In January 2010, Central Vermont Community Action Council received $4.8 million from the DOL to create a statewide partnership to train workers for jobs in the growing green sector. Named the Vermont Growing Renewable Energy/Efficiency Employment Network (Vermont GREEN), the partnership engaged more than 30 organizations: nonprofits, training providers, higher education institutions, private industry, organized labor, state agencies, workforce boards, and industry associations. Partners attended quarterly advisory board meetings to help coordinate statewide recruiting and placement efforts, assist with annual job summits, build new avenues for strategic partnering, and examine future funding opportunities. At the time of the study, Vermont GREEN was working with state economic and workforce development officials to conduct a broad survey of green businesses to identify economic development needs.

The educator interviewed for this study stated that these stakeholder activities had resulted in new institutional capacity in her school to respond to needs of the green industry:

> The coalition of partners that Vermont GREEN pulled together for this project … shows me the whole system. It shows me where my weaknesses are and gives me the opportunity to brainstorm solutions with folks who … share the same end-goal. … We've been able to course-correct and adjust pretty quickly to some feedback we've gotten.

In addition to extensive stakeholder engagement in the partnership's strategic planning, grant funds support a three-pronged workforce strategy:

(1) *Support the extensive, state-sponsored weatherization program*. Homeowners living in low-income neighborhoods can apply for state funds to weatherize their homes. In turn, the state requires homeowners to hire local contractors, who themselves must hire local residents to perform this weatherization work. The state pays for the training and certification, while Vermont GREEN recruits the trainees and provides wraparound support services to ensure trainees succeed in the program and are placed in weatherization jobs.
(2) *Work with a network of community action agencies to offer extensive career counseling*. Counselors help residents assess their interests and training needs, access relevant federal- and state-funded green training programs, and secure a job.
(3) *Offer customized training services to meet the specific needs of green regional employers and union apprenticeship programs*. Vermont GREEN pays for a portion of this training and leverages this investment to help employers tap other public and private resources to pay for training. All customized training must result in an industry-recognized certificate.

The workforce development agency representative also discussed how Vermont GREEN was working to connect all the dots in the state's green sector to leverage and integrate a wide variety of resources to deliver workforce development programs. This approach, he believed, would also help to ensure the effort was sustained beyond the grant period.

ReNW

Oregon is home to the most concentrated and fastest-growing green jobs sector in the nation (Pew Charitable Trusts 2009). The approximate 51,000 green jobs in 5000 firms comprise about three percent of the state's employment. Oregon is also home to one of the country's largest solar manufacturing clusters with the largest concentration of wind-generated electricity. The supply chain for these sectors is largely overseas, adding to the cost of creating the infrastructure for the industry. Filling this gap is at the heart of the ReNW strategy.

In early 2010, Oregon Manufacturing Extension Partnership received a $5 million grant from DOL to launch Renewable Northwest (ReNW). ReNW

engages public and private partners in the renewable energy industry across six counties in Oregon and three contiguous counties in Washington. Its mission is to grow the region's renewable energy industry, infuse sustainable manufacturing practices into its supply chain, and develop workers with the skills required to work in the green energy industry.

ReNW had roots in a $5 million DOL grant awarded to the region in 2007 under the Workforce Innovation in Regional Economic Development (WIRED) program. The grant connected the community colleges and workforce and economic development agencies to build new institutional capacity to support the manufacturing sector, including a new centralized labor market information system, career pathways linked to training and certification for manufacturing occupations, and other workforce and economic development support for the industry. Many interviewees noted that WIRED created a spirit of collaboration across agencies that ReNW was leveraging to support the green industry sector. ReNW also developed a three-pronged strategy:

(1) *Economic development strategy*. To cultivate new markets in the renewable electricity industry for the area's small and midsized manufacturers, ReNW works with providers to determine their needs for equipment and component parts, build a local supply chain, and upgrade the manufacturing workforce and production system.
(2) *Workforce development strategy*. ReNW engages regional Workforce Investment Boards (WIB) to recruit workers and refer them to jobs and/or training and certification programs. Area education providers provide the training either through degree-granting programs or customized training offered to individual employers.
(3) *Job placement strategy*. ReNW counselors work with green employers to place workers in green jobs. At least 13 employers in the ReNW network have agreed to provide workers referred by ReNW counselors first consideration for all open positions.

In the first year of the partnership, ReNW leveraged an additional $3 million from the US Department of Commerce, National Institute of Standards and Technology manufacturing extension partnership program to support its work with the suppliers and extend the ReNW project across both Oregon and Washington states. Other ReNW partners have also contributed funds to support outreach to business, program development, and participant training.

Cross-Case Analysis

Employers

Four employers were interviewed for this study, two from each case. The Vermont GREEN employers, Batteries Inc. and Home Energy Inc., were manufacturing companies launching a new green product line. The ReNW employers, Wind Inc. and Solar Inc., were contractors providing installation and repair services to the renewable energy industry.

Vermont GREEN Both Vermont employers were entering into new green markets that required internal changes. In Batteries Inc., the change was significant. Prior to the formation of Vermont GREEN, the firm received $9 million from the US Department of Commerce and the State of Vermont to develop a new capacitor for the auto industry and to build a new state-of-the-art production facility. All jobs were significantly upgraded, and workers needed training and certification in new processes and equipment. Home Energy Inc. was planning to launch a new product line of renewable energy systems to the residential market. Since the firm was in the early stage of product development, the employer was not clear about how the new product would affect production processes and jobs.

Both companies anticipated adding new jobs. Batteries Inc. projected 132 new assembly jobs. Because it was using a state wage subsidy program for these positions, the base starting salary was set at the required $12.90 per hour plus benefits. Home Energy Inc. could not project a specific number of new jobs and did not anticipate raising the wages for its assembly jobs, which ranged from $11.00 to $15.00 per hour plus benefits. In both firms, the wages for assembly jobs matched the national median hourly wage of $12.89 at the time of this study. Batteries Inc. saw great career potential in the new green jobs. Home Energy was less clear about the career potential of the assembly jobs, though employees were excited by the new green products and the opportunity to make a meaningful contribution through their work.

Both employers looked to Vermont GREEN for support in developing internal training and certifications in the new work systems, equipment, and tasks. Batteries Inc. was developing a broad-based curriculum in advanced manufacturing that would help individuals develop portable skills, even though the certification would not be recognized outside of the employer. Home Energy Inc. was planning to implement a new lean training and certification, a need shared by Batteries Inc. Though these two employers

shared several common training needs, Vermont GREEN appeared to be serving them separately. The opportunity may exist for the GJTP to think more broadly about the design and delivery of its customized training.

The firms also shared a common challenge in balancing the new green products' sales cycle with the anticipated job growth. They knew they needed to hire new workers and train existing workers, and they also knew this would require planning and time to implement. However, they also saw a risk of growing the workforce before the new business was in place to support the additional training and payroll. Both employers thought that the support from Vermont GREEN and, in the case of Batteries Inc., the state's wage subsidies helped minimize this risk. Both also planned to cross-train employees, so they could move workers from one line to another to match variable sales cycles.

ReNW Both ReNW employers interviewed for this study required specialized skills not broadly available in the labor market. Wind Inc.'s wind repair tech jobs required knowledge and expertise in composites, which was not taught in the region's wind technician training program. In fact, since this occupation was so new, the wind farm repair sector had no resource to train and certify workers—a situation that led to significant quality problems. To address this gap, Wind Inc. was working with ReNW and the American Composite Manufacturers Association (ACMA) to develop and pilot a new wind blade repair training and certification that ACMA planned to make broadly available to the industry. The Oregon Community College representative to the GJTP was also engaged. The college would deliver the training at Wind Inc. and it would integrate the training and certification into the statewide green career pathway.

Solar Inc., on the other hand, required expertise in solar installation, including knowledge of the codes and of the particular systems being installed. Though the regional apprenticeship programs provided this training, the employer believed these skills were best learned on the job, and many skilled trade workers did not come to his firm with the skills for this work. This employer was working with ReNW to provide on-the-job training in solar installation to the workers hired for the busy summer season.

The jobs in both firms were seasonal jobs requiring specialized skills. Wind Inc. paid $20.00 per hour for the wind repair technician job (compared with a national median of $17.00), and Solar Inc. paid $10.00 to 20.00 per hour for the variety of semiskilled and skilled trade jobs in the firm (compared with a national median of $16.34 for solar installers). Both employers paid full benefits. Wind Inc. did not offer internal career advancement opportunities

but employees with credentials in wind technology were often hired by the wind farms for higher-paying, more secure jobs. Solar Inc. employees could advance through the apprenticeship system and receive pay increases for time with the company.

Both employers viewed ReNW as a source of extra financial support for preexisting needs and projects. Wind Inc. had been working with the WIB and the ACMA to carve together the resources needed to develop and pilot a new national training and certification for wind blade repair. The ReNW grant was a boost to this effort, since it allowed the parties to get it off the ground and bring it to scale sooner than anticipated. Solar Inc. drew on ReNW to hire and train workers needed for the summer season. This on-the-job training was of value to the individual employees and the regional industry because it gave the employees new skills they needed to work in the industry while compensating Solar Inc. for investing in the training. The owner also taught a community college course on introduction to solar installation. Thus, both employers were investing time and expertise to build the skilled workforce they needed to service the renewable energy industry in the region.

Educators

Three educators were interviewed for this study, one from Vermont GREEN and two from ReNW. Each was active in the green industry and green labor market prior to the GJTP, so their green-related programs extended beyond the grant-funded activities.

Vermont GREEN The Vermont GREEN educator represented a private technical college's new Center for Sustainability, which focused on building capacity to support the region's green industry and to help create jobs for graduates. The center provided training and certification leading to industry-recognized credentials.

The educator assisted with the start-up of Vermont GREEN by leveraging the center's weatherization program and aligning it with the emerging Vermont GREEN network of counselors and job developers. The new Vermont GREEN student pipeline required increased capacity at the center. Finding space and instructors to meet this demand was challenging. Another challenge was that the weatherization of homes in Vermont had fallen off and the center could not find many jobs for its students. This situation led the

educator to consider new ways to connect this short-term training to a broader continuum of education at the college to provide students with deeper skills and more employment security.

The educator saw great value in Vermont GREEN because it connected her to the green industry sector and provided her with timely feedback to improve programs. Ironically, however, the educator reported very little interaction with employers around curriculum and program development. The educator was not involved in, nor was she very knowledgeable about, the in-house training occurring in Batteries Inc. and Home Energy Inc.

ReNW On the other hand, the two educators involved in ReNW were very engaged in hands-on program development and implementation activities with individual green employers in the region. These educators represented community colleges in Oregon and Washington.

Oregon had invested in the development of green jobs career pathways to link green education and certification across all levels of the state's education system, including high school career and technical education, community colleges, and bachelor's and graduate education programs. The Oregon Community College representative to the ReNW was instrumental in integrating the new wind service technician training and certification into the state's green career pathways program.

In Washington, the approach was to integrate green training and certification programs into broader industry and occupational career pathways. For example, the manufacturing career pathway included training and certification on green manufacturing. The impact was that in Oregon, the green training provided by ReNW was nested in an expanding continuum of green jobs education available throughout the state. Oregon workers who participated in ReNW-sponsored training could apply it toward a broader degree. In contrast, in Washington, the ReNW training was similar to the training in Vermont—short-term, noncredit, certificate-oriented training in skills of value to industry.

These structural variations did not seem to affect the role each educator played in ReNW or the process they used to engage in GJTP-sponsored projects. Both educators described their experience in ReNW in a similar way. Each leveraged existing, albeit small projects and relationships and aligned them to support ReNW's economic and workforce strategy and, in so doing, succeeded in bringing their projects to a broader scale in the region.

WIB Representatives

One workforce development representative was interviewed for each site. The workforce development representative in Vermont described Vermont GREEN as part of a broader strategy in the State workforce system to fill the gap in the education and training infrastructure for non-college-bound youth and working adults by providing short-term training in skills and credentials leading to jobs. Unlike in Oregon, these short-term certification programs were not linked to the state's broader continuum of education.

Another difference related to the role played by the WIBs in fostering relationships among the stakeholders in the industry's workforce development system. In Vermont, although stakeholders were involved in industry-level strategic planning, there was very little direct interaction between educators and employers on the program level. The WIB helped the GJTP broker the training for each employer stakeholder. In Oregon and Washington, on the other hand, there was a high degree of collaboration between employers and educators. In fact, ReNW staff did not directly engage in program activities, opting instead to provide education and economic development agencies with the funds to support their work in the green sector.

Aside from these differences, the WIBs played a vital role in the formation of both GJTPs, and they continued to contribute to its development and long-term sustainability through outreach and technical assistance in strategic planning and program development.

Conclusions

Effect on Creation of Good Green Jobs

The movement into the green sector provided the two Vermont GREEN manufacturing firms an opportunity to rethink the basic structure of their production process and to reorganize the work in ways that demanded more skills and potentially provided increased pay and new advancement opportunities for workers. The availability of public economic and workforce development funds, including the funding from Vermont GREEN, allowed the employers to offer training and certification programs to help workers meet the new skill requirements. In addition, both employers intended to train entry-level workers as well as offer ongoing training to incumbent employees. The greening of the workplace in these two firms led the employer to upgrade the jobs and improve the structural conditions of work. Therefore, this study

found that in the case of these two employers, the greening of the workplace resulted in better, if not good, jobs for workers.

The question of whether these improvements to job quality were the direct result of the GJTP remains open, however. The Vermont GREEN employers were clear that they changed conditions in response to new customer demands, the skill requirement of new systems and equipment, and the requirements of external government funds supporting their transition, including but not limited to Vermont GREEN. So, it appeared that multiple factors shifted working conditions in the green sector.

The green jobs offered by the ReNW employers provided decent entry-level pay ($15–20/hour) and benefits. Each employer mentioned that these jobs offered career opportunities for workers who continued in their training and who gained more experience in the industry. By these standards, these jobs can be judged as good jobs. However, these jobs were also seasonal and in industries that were not very stable. Training and certificates in renewable energy occupations and skills may help provide more job security, but there may be a need for new mechanisms, like those found in the apprenticeship system, to help workers transition from one job to the next. Again, job quality was linked to a wide range of factors and not to the efforts of any one initiative or program.

Effect on the Functioning of Labor Market Institutions

In Vermont GREEN, the GJTP emerged as a centralized institution with a mission to connect and engage public and private partners to advocate for new policies and build a new strategy to support the state's green sector. The interaction between the employers and the supply-side actors in Vermont GREEN occurred through these strategic, industry-level activities. However, the employers were unclear how this engagement connected to their work with the workforce development activities funded by Vermont GREEN. In addition, Vermont GREEN's investments in these two firms were limited to the internal labor market needs of the firms. Therefore, the investments did not have the reciprocal effect of improving the effectiveness of the educational system to respond to ongoing needs of the industry.

In the Northwest, the institution of ReNW occurred in the context of a decentralized network of workforce and economic development institutions engaged in a variety of economic and workforce development projects; the GJTP grant helped to focus this work on the renewable industry. In this light, ReNW appeared more as a funded effort to build and enhance the capacity of

a wide range of labor market institutions in the region to collaborate in the development of a response to the needs of the renewable industry.

This broader focus on improving the functioning of the regional labor market institutions was observed in how Oregon Community College, through the use of ReNW funds, worked with Wind Inc. to build a new training and certification program to fill a significant skill gap in the industry. Indeed, both ReNW employers were working within the broader education and workforce systems, both locally and nationally, to advocate for and contribute to the development of new training and certification programs that would make specialty skills broadly available throughout the labor market.

The difference in strategy between these two cases may lie in their preexisting institutional frameworks. The contiguous counties in Oregon and Washington included in ReNW were also part of a 2007 WIRED grant that established a workforce development infrastructure in the manufacturing sector. Many of the supply-side partners interviewed for this study were engaged in that effort, and all spoke about how the new GJTP funds allowed them to continue to refine programs and strengthen relationships initiated under WIRED. In addition, Wind Inc. talked about the powerful developmental effect that the Oregon Community College green initiative had on its ability to build a program, which itself was nested in a broader career pathway that provided workers with access to ongoing educational opportunities.

Vermont GREEN lacked such a broader context and network; however, the outreach and strategic planning underway in the GJTP may help connect the dots among state institutions engaged in economic and workforce development and link resources to support the development of the green industry. In this light, Vermont GREEN appeared as a new institutional entity supporting economic development of the green industry sector in the state, whereas ReNW was a regionwide planning process that helped preexisting labor market institutions leverage their programs and relationship to support the green industry in the region.

Lessons Learned

The basic premise explored by this case study was that the shift to the green economy to support sustainability of the environment could, under certain conditions, transform the nature of work, making it more equitable, and improve the functioning of labor market institutions. This study resulted in

several lessons related to this premise that can inform other efforts to support a shift to a sustainable, green economy:

- *Policy leaders and workforce practitioners can help close the equity gap by leveraging external market dynamics and public investments in green industries to improve working conditions and stabilize the green jobs labor market*. The green employers in this study were responding to a myriad of market and regulatory pressures with workforce strategies that upgraded skills, improved working conditions, and provided workers with advancement opportunities. This finding affirms that green jobs can both improve the environment and close the equity gap if policy makers and leaders leverage market dynamics and public investments to move green employers to adopt a work system based on high quality and skill standards.
- *Policy leaders and workforce practitioners can leverage public investments in the green economy to improve the functioning of labor market institutions and programs*. Primarily in the ReNW case, policy leaders and practitioners leveraged public and private investments in new workforce education and certificate programs for emerging green jobs to make enhancements to the broader green jobs workforce development system. The wind blade repair tech program, for example, was being incorporated into a broader continuum of education in the Oregon Community College system, as well as being brought to scale nationally through a partnership with the national employer association. In so doing, this new wind blade repair tech program enhanced the ability of the Oregon Community College system, as well as the national trade association, to improve their own capacities to respond to the needs of the growing green sector. Future federal efforts to support the development of innovative workforce development initiatives in targeted industries should consider the recipients' capacity to quickly bring efforts to scale regionally and across the industry.
- *Responsive and effective economic and workforce development strategies in the green sector, and perhaps other emerging economic sectors, must emerge from within local relationships and conditions.* The two GJTPs in this study were very different in terms of form and function. Vermont GREEN was developing a centralized institution to connect the dots between the supply and demand sides of the green labor market in the state. Though this model did not conform to the broader systems-building approach advocated by many policy leaders and seen in Oregon, in this case this approach resulted in stronger ties and improved relationships between previously disconnected actors. Workforce development practices could be enhanced by an awareness of the local conditions that are so important for building new capacity.

Challenges and Barriers

These two GJTPs faced several challenges related to improving the capacity of regional labor market institutions to support the green economy. Addressing these challenges will hasten the emergence of the dual promise of green jobs to improve the environment and close the equity gap by growing good industries and jobs:

(1) *Current workforce development practices, and some policies, thwart the development of the effective partnerships that were instrumental in these two case studies in building effective programs and improving the responsiveness of labor market institutions to the needs of the green industry*. Each of the government and education participants in the ReNW case spoke of how the WIRED initiative fostered a new spirit of collaboration among previously disconnected, and in some cases competing, public agencies and programs. This collaboration resulted in new resources and increased flexibility within the public workforce and economic development system that made programs and services more responsive to the needs of industries and workers. Without the WIRED grant's requirement for collaboration, these informants did not believe the parties would have had the incentive to work together to improve the functioning of labor market systems. New incentives and regulation requiring public agencies to work together in servicing industries, like the green sector, targeted for economic development may be required if the investments are to result in improvements to the public system. However, the federal government is not likely to impose such requirements in today's political climate.

(2) *Traditional workforce planning and development strategies and methods are ineffective in responding to the needs of emerging sectors and occupations and therefore thwart their development*. Workforce development plans that drive the preparation of the workforce are often based on the analysis of a small number of supply and demand variables that do not account for the dynamic changes taking place in new and emerging industries. In addition, the conventional process is linear, sequential, and protracted; employers hand off an analysis of needs to educators who are then expected to respond with education and training to prepare the workforce (Pittman and Scully-Russ 2016). In the two cases described here, although the parties departed from these conventions by accounting for more factors in the program development process and engaging in a highly interactive planning process, participants still expressed reservations that

training investments were premature, jobs were not yet solidified, and needs were not well understood. Everyone understood that workforce development in this context was risky because there was little certainty that training would match the jobs as they emerged and that jobs would be there to employ trainees. New methods to synchronize the supply and demand in the labor market and to anticipate future needs in an ambiguous and uncertain context are required.

Further Reading

In addition to the resources listed in the reference list, the following readings are suggested for those who seek to develop a deeper understanding of a sustainable economy and the green jobs labor market.

Basol, O. 2014. Classic or Modern: Enhancement Of Job Satisfaction Scale for Green Job Workers. *Management* 11 (2): 103–122.

Bowen, K., and K. Kuralbayeva. 2015. *Looking for Green Jobs: The Impact of Growth on Employment*. Seoul: Global Green Growth Institute.

Brown, M. 2015. Developing and Using Green Skills for the Transition to a Low Carbon Economy. *Australian Journal of Adult Learning* 55 (2): 182–203.

Consili, D., G. Marin, Z. Marzucchi, and F. Vona. 2016. Do Green Jobs Differ from Non-green in Terms of Skill and Human Capital? *Research Policy* 45 (5): 1046–1060.

Hess, D.J. 2012. *Good Green Jobs in a Global Economy: Making and Keeping New Industries in the United States*. Cambridge, MA: MIT Press.

Leszczynska, A. 2016. Conceptualization of Green Human Resource Management. In *16th International Scientific Conference on Economic and Social Development—"The Legal Challenges of Modern World" Book of Proceedings*, ed. Z. Primorac, C. Bussoli, and N. Recker, 431–441. Koprivnica: Varazdin Development and Entrepreneurship Agency.

Scully-Russ, E. 2012. Human Resource Development and Sustainability: Beyond Sustainable Organizations. *Human Resource Development International* 15 (4): 399–415.

Strietska-Ilina, O., C. Hofmann, M.D. Haro, and S. Jeon. 2012. *Skills for Green Jobs: A Global View*. Geneva: International Labour Organisation.

US Government Accountability Office. 2013. *Employment and Training: Labor's Green Jobs Efforts Highlight Challenges of Targeted Training Programs for Emerging Industries* [Report to Congressional Requesters]. Washington, DC: U.S. Government Accountability Office. Available at: <https://www.gao.gov/assets/660/655331.pdf>

References

Appelbaum, E. 2012. Reducing Inequality and Insecurity: Rethinking Labor and Economic Policy for the 21st Century. *Work and Occupations* 39 (4): 311–320.

Cleantech Group, LLC. 2009. *Clean Technology Venture Investment Falls to $1 billion in 1Q09*. Press release.

Conway, M., and R.P. Giloth. 2014. *Connecting People to Work: Workforce Intermediaries and Sector Strategies*. Aspen: Aspen Institute.

Curson, J.A., M.E. Dell, R.A. Wilson, D.L. Bosworth, and B. Balduf. 2010. Who Does Workforce Planning Well? Workforce Review Team Rapid Review Summary. *International Journal of Health Care Quality Assurance* 23 (1): 1–9.

Ehresman, T., and C. Okereke. 2015. Environmental Justice and Conceptions of the Green Economy. *International Environmental Agreements* 15: 13–27.

Goerner, S.J., R.G. Dyck, and D. Langerroos. 2008. *The New Science of Sustainability: Building a Foundation for Great Change*. Chapel Hill: Triangle Center for Complex Systems.

Hartman, C., and G.D. Squires, eds. 2006. *Pre and Post Katrina. There Is No Such Thing as a Natural Disaster: Race, Class and Hurricane Katrina*. New York: Routledge.

Jones, V. 2008. *The Green Collar Economy: How One Solution Can Fix Our Two Biggest Problems*. New York: Harper One.

Kelleberg, A.L. 2011. *Good Jobs, Bad Jobs: The Rise of Polarized and Precarious Employment Systems in the United States 1970s to 2000s*. New York: Russell Sage Foundation.

Korten, D.C. 2001. *When Corporations Ruled the World*. San Francisco: Berrett-Koehler.

Lipfert, F.W. 2004. Air Pollution and Poverty: Does the Sword Cut Both Ways? *Journal of Epidemiology & Community Health* 58 (1): 2–3.

Marshall, R., and H.A. Plotkin. 2010. Creating a 21st Century Workforce Development System. In *Transforming the US workforce Development System: Lessons From Research and Practice*, ed. D. Finegold, M. Gatta, and S. Schurman, 285–314. Champaign: Labor and Employment Relations Association.

Pachauri, R.K., M.R. Allen, V.R. Barros, J. Broome, W. Cramer, and R. Christ. 2014. *Climate Change 2014: Synthesis Report. Contributions of Working Groups I, II, and III to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change*. Geneva: Intergovernmental Panel on Climate Change.

Pew Charitable Trusts. 2009. *The Clean Energy Economy: Repowering Jobs, Businesses and Investments Across America*. Washington DC: Pew Charitable Trusts.

Pinderhughes, R.R. 2007. *Green Collar Jobs: An Analysis of the Capacity of Green Businesses to Provide High Quality Jobs for Men and Women with Barriers to Employment*. Berkeley: City of Berkeley Office of Energy and Sustainable Development.

Pittman, P., and E. Scully-Russ. 2016. Workforce Planning and Development in Times of Delivery Systems Transformation. *Human Resources for Health* 14 (56): 1–15. https://doi.org/10.1186/s12960-016-0154-3.

Renner, M., S. Sweeney, and J. Kubit. 2008. *Green Jobs: Towards Decent Work in a Sustainable, Low-carbon World*. Nairobi: United Nations Environment Programme.

Schmid, G. 2006. Social Risk Management Through Transitional Labor Markets. *Socio-Economic Review* 4 (1): 1–33.

Smit, S., and J. Musango. 2015. Exploring Connections Between the Green Economy and Informal Economy in South Africa. *South African Journal of Science* 11 (12): 151–161.

Speth, J.G. 2010. Towards a New Economy and a New Politics. *Solutions* 1 (5): 33–41.

Stone, J.R. 2010. It Isn't Easy Being Green, or Is It? *Techniques: Connecting Education and Careers* 85 (3): 42–45.

Vermont Environmental Consortium. 2009. *Vermont's Environmental Sector: Identifying Green Workforce Training Needs and Opportunities*. Norwich: Vermont Environmental Consortium and Yellow Wood Associates.

28

Is Ecotourism Sustainable? A Case Study from Sri Lanka

Rathnayake Mudiyanselage Wasantha Rathnayake

Ecotourism *is a form of tourism involving visiting fragile, pristine, and relatively undisturbed natural areas, intended as a low-impact and often small-scale alternative to standard commercial (mass) tourism.*

Background

The Pitawala Patana Forest Reserve is conserved and managed by the Forest Department of Sri Lanka, which makes it the body responsible for the planning and implementation of tourism activities/recreational schemes at the reserve. However, as a government body, the Forest Department should not take an active role in the implementation of recreational schemes, confining itself to oversight and monitoring of such activities in order to ensure that they do not compromise or violate the conservation principles applicable to the forest reserve.

The origin of the term "ecotourism" is often attributed to Ceballos-Lascurain (1987) who used it to describe nature-based tourism in tropical areas (Boo 1990). The term was interchangeably used with nature tourism by Boo (1990) who defined ecotourism as visits "to national parks and other natural areas with the aim of viewing and enjoying the plants and animals as well as any indigenous culture." However, even as the ecotourism industry

R. M. W. Rathnayake (✉)
Faculty of Management Studies, Sabaragamuwa University of Sri Lanka, Belihuloya, Sri Lanka

R. Brinkmann, S. J. Garren (eds.), *The Palgrave Handbook of Sustainability*,
https://doi.org/10.1007/978-3-319-71389-2_28

began to flourish and more studies on the subject became available, the term "ecotourism" came to be subsumed under the umbrella category of nature tourism as one of its subsets.

Definitions of ecotourism abound (Orams 1995; Wight 1993; Boyd and Butler 1996; Mandziuk 1995; Herath 1996; Buckley 1994; Linberg et al. 1996; Nelson 1994). But they all contain some common characteristics such as nature-based tourism; appreciation of nature as the primary motive for participation; fostering the conservation of the natural resource base on which it depends (which translates into protecting and minimizing negative impacts on the environment); providing benefits to local hosts (which translates into economic opportunities); respect for local culture and minimizing social impacts; and promoting environmental education to visitors.

Although nature has always offered a variety of resources for tourism in different areas, proper understanding of the natural environment in question as well as the significance and importance of the resources are essential for decision-makers at all levels to make the right decisions and appropriate plans for improving ecotourism in a particular region (Ashouri and Fariyadi 2010). However, the term "ecotourism" has traditionally made few references to conservation ethics, referring simply to travel to natural areas (Heintzman 1999); ecotourism has the potential to draw attention especially to tourism's potential as a sustainable development tool. Ideally, ecotourism activity strives for minimal impact on the environment; ensures that the host community maintains its control over natural resource exploitation and its own destiny; and has in place sensitivity plans that keep long-term community development in focus (Heintzman 1999).

In the midst of the considerable international debate on the definition of ecotourism, the Sri Lanka Tourist Board has adopted the following in the National Ecotourism Policy drafted in 2003: "Responsible travel to natural and cultural areas that conserves the environment and improves the well-being of local communities" (SLTB 2003). The policy also outlines the principles, objectives, and actions that are necessary to facilitate the development of a sustainable tourism industry that contributes to resource conservation while optimizing economic benefits for the current and future generations of Sri Lankans. It is supported by the National Forest Policy of 1995.

The following key principles should be entailed in ecotourism as defined by the Sri Lanka Tourist Board (2003):

- Environmentally sound development with no degradation of the resource, preferably with long-term benefits (economic or otherwise) to the resource
- Benefits to local communities and peoples, through such means as participation in decision-making, employment, management, ownership, education, self-reliance and fulfillment, or strengthening culture

- Economic benefits to industry participants and
- Education and interpretation to provide participatory, enlightening, and respectful experiences

Although the national framework for tourism development, National Tourism Development Act was amended in 2008, Sri Lanka Tourist Board's Ecotourism Strategy (2003) and Sri Lanka Forest Department's National Forest Policy (1995) are still supportive for these principles.

The definition of ecotourism is "responsibility to travel to natural areas that conserves the environment and sustains the wellbeing of local people" (Elper Wood 2002). As such, the ecotourism potential consists of three major components: responsibility to travel to natural areas, conservation of the environment, and sustenance of the well-being of the local people. Sustainability of ecotourism requires that all three criteria be met by protected area managers.

But providing ecotourism opportunities to tourists means making available the resources that local community and industry participants need to get involved in ecotourism activities. Ecotourism is typically provided by a network of businesses that, together, offer the different products and services needed by the ecotourist. This includes food services and food supplies, sports and outfitting equipment and supplies, lodging, and guide services. For ecotourism businesses to be successful, they must therefore have the following underlying characteristics that are given in Table 28.1 which lists the three main parts of the ecotourism definition and includes the factors that are found in any successful business.

Ecotourism takes the natural environment as its backdrop. But such activity does not take place in a space completely outside or devoid of the sociocultural context, including the history, of the host community and of the area against the backdrop of which the experience provided to tourists unfolds. Therefore, in parts of the world where ecotourism as a concept is embraced and practiced, it is customary to provide education to both the ecotourists and the local people to increase awareness of the importance of nature. Such awareness is typically provided through nature interpretation and outdoor activities. A third important aspect to keep in mind when initiating ecotourism is the business aspect which requires that factors affecting the viability and profitability of the ecotourism enterprise be addressed in order to interest and encourage private entrepreneurs to invest in such ventures. "Community development" refers to "how" and "what" ecotourism contributes to the locale in question and the people who inhabit it. Natural resource conservation is necessary because ecotourism is a form of nature-based tourism and, as such, depends on the preservation of the natural environment in its original state for its existence.

Table 28.1 Major parts of the ecotourism definition and the factors to be included in each part of the definition

Major parts of the definition of ecotourism	Factors
Environmentally conscious nature-based travel enjoyed by people interested in learning about the nature, history, and culture of the area visited	Natural environment Culture Education Travel People
Providing economic and social benefits to host communities by expanding the community's economic base	Economic Social Community Contributing to well-being
Contributing to natural resource conservation through nature interpretation and environmental education	Natural resource conservation Education

Factors listed in Table 28.1, and those identified from the literature review, are grouped into environmental, economic, and social factors. These factors are described in the following paragraphs.

Environmental Factors

Following Mathieson and Wall (1982), environmental factors here refer to the natural environment which includes the natural features and the ecological processes that define a particular area. Natural features, such as scenic vistas and landscapes, climate, topography, wildlife, and vegetation, are important to the type and level of tourism in an area (Bird and Inman 1968; Mathieson and Wall 1982). But the relationship between the natural environment and ecotourism can also be seen as symbiotic because the latter can play an important role in natural resource conservation as part of the income from tourism can be re-invested in maintaining natural areas (Budowski 1977, In: Mathieson and Wall 1982). This aspect to ecotourism enables it to play a role in both the rehabilitation of old and the creation of new sites and to foster administrative and planning mechanisms such as enforcing restricted access to sensitive areas which would help preserve and maintain the quality of the natural environment. Another important factor in tourism demand is the actual physical location of the unique natural environment in question. Usually, rural locations that are relatively close to metropolitan areas enjoy higher demand than those tourism locations in more remote areas (Bird and Inman 1968; Mathieson and Wall 1982).

Thus, it can be said that the goals of ecotourism management strategies are to protect the natural environment while providing the tourist with a great

ecotourism experience. Ecotourists are those whose travels are motivated by an interest in wilderness, wildlife, and national parks, an interest in learning more about natural environments, and a desire for outdoor activity. Thus, these ideas should underlie the management of ecotourism (Eagles 1997). Orams (1995) believes that ecotourism should adopt a proactive stance toward the natural environment against the backdrop of which activities are organized for the tourists so that these activities contribute to the health and viability of the environment in question. However, this has not always been the case. There have been instances when, despite good intentions and attempts to reduce the negative effects on the natural environment, tourism has been detrimental to the environment. Damaged vegetation, disruption to wildlife, soil compaction, water quality problems, and air and noise pollution are but a few of the negative environmental effects caused by tourism (Mathieson and Wall 1982). Furthermore, protected areas (e.g., national and state parks) have undergone the cumulative and interactive effects of many small-scale, independent, low-intensity tourism developments over the decades (Nelson 1994). Hence, it must be borne in mind that a significant increase in the number of ecotourism activities is bound to pose environmental problems because, despite being non-consumptive and low-impact, ecotourism initiatives cannot help but consume resources and generate waste.

Economic Factors

According to Mathieson and Wall (1982), economic factors refer to those factors related to economic structure and economic development, including the economic base, patterns of investment, and economic leakages that are of relevance for ecotourism initiatives. Tourism can help the stability of local economies by diversifying the economy through the creation of businesses providing tours and catering to the diverse needs of tourists. However, it is also a fact that the seasonal character of tourism creates inevitable economic fluctuations that can be detrimental to the stability of the local economy unless adequately accounted for. Availability of personnel skilled in the provision and management of tourism enterprises is also key to tourism success. In case of non-availability, educational programs must be instituted to train such personnel. Local investments in tourism are also of utmost importance in strengthening the local economy and in minimizing economic leakages. Economic leakages occur when profits generated locally are exported (i.e., "leaked") to another locale. The success of ecotourism enterprises also

hinges on marketing and human resources (Mandziuk 1995). As Mandziuk (1995) has pointed out, cooperative marketing is an affordable marketing strategy that individual businesses can adopt in order to attract visitors to an area. For agencies located in and concentrating on a particular region, symbols, images, and other regional characteristics which set the region apart from others are strategies to be adopted in order to attract visitors to that region.

Social Factors

Social factors refer to social structure and organization, including demographic characteristics, availability and quality of social amenities, attitudes toward tourists, and local traditions and culture (Mathieson and Wall 1982) of a particular area or region that may help or hinder tourism initiatives. It goes without saying that a friendly and cooperative host community would enhance local business opportunities to foster tourism (Bird and Inman 1968). Focusing on impacts, Mathieson and Wall (1982) have suggested that social factors could take the form of changes in values, relationships, lifestyles, quality of life, behavior, and creative expressions of the community in the locale under consideration.

Other Factors

No two ecotourism initiatives, however, will be identical as the context or milieu in which such initiatives are to unfold is bound to be different one from the other. Hence, each ecotourism initiative should be defined in such a way as to assume a local cast and implemented in terms of activities and structures that take the needs of the specific context or milieu into account, and with full cognizance of the potential environmental, cultural, and economic fallouts of such initiatives for the host area (Nelson 1994). Visitor guidelines are key in enhancing the appropriate behavior of visitors to both cultural and natural areas. Ecotourism guidelines are one way to highlight the expected behavior of visitors with respect to nature and to the host community and to advise them on environmentally sensitive and low-impact activities (Mandziuk 1995). Two important factors outlined by Moore and Carter (1993) for successful ecotourism destinations hence go beyond the quality of services and facilities in order to include the quality of the experience itself and the positive host environment.

Therefore, in the present study, we assess the sustainability of the ecotourism concept applied in the Pitawala Patana Forest Reserve under the following research objectives:

- To identify the visitors' views/opinions/perceptions on the responsibility associated with travel to Pitawala Patana
- To identify the existing ecotourism operations at the Pitawala Patana to help conserve the environment
- To explore whether local people derive benefits from ecotourism at Pitawala Patana

Case Study

Study Area

The Knuckles forest range is emerging as an ecotourism site owing to its natural scenic beauty, favorable climate, and numerous types of ecosystems and habitats. It is also accessible from the Kandy-Matale road. Ecotourism activities are beginning to emerge in this area at present, with around 35 percent of the households running boutiques as well as other businesses such as facilities for trekking (Wickramasinghe et al. 2006). The area selected for this study is the Pitawala Patana area, administered by the Forest Department in Sri Lanka. The Pitawala Patana area as well as the private lands surrounding the Knuckles mountain range has been declared as an environmentally sensitive area under the National Environmental Act (CEA 2007), and the area has been identified as one containing both scenic beauty and high biodiversity in the Knuckles Conservation Forest plan. However, human activities have more or less destroyed both the scenic beauty and the biodiversity of the area (Bambaradeniya and Ekanayake 2003). Annually, the Pitawala Patana area is visited by 25,000 tourists, which generates an annual revenue of approximately SLR one million. In such a situation, policy makers should consider ecotourism initiatives as a sustainable solution that combines the need for biodiversity conservation with the economic interests of the local community given that tourism in the area is partially dependent on natural resources.

Identification of Visitor Characteristics, Reasons for Visiting Pitawala Patana, and Visitor Perceptions

The present study is based on a number of questionnaire surveys conducted during the study period. Since surveying all visitors to Pitawala Patana was

both difficult and impractical, several reconnaissance surveys were conducted and visitation patterns observed in order to get a rough idea of the type and number of visitors to the site. The surveys showed that Pitawala Patana gets more visitors during the school vacations compared to the other months. In the case of foreign visitors, the numbers to the national parks were higher between September and March than other months of the year. The sample sizes were determined on the basis of the background information collected via reconnaissance surveys and through the pre-testing of questionnaires.

A sample size of 550 was statistically chosen (Yamane 1967), which meant that every fourth visitor group coming out of the reserve, having enjoyed Pitawala Patana, was chosen as a sample. At the reserve entrance office, either the leader or a member from each group who volunteered to provide information was interviewed face to face. We opted for this technique because it helped us to get a precise sample while simultaneously being easy to implement. The questionnaire was organized into two sections. While the first part of the questionnaire captured visitor information including socio-economic characteristics, the second part collected information on the recreational behavior of visitors, the recreational activity they indulged in at the park, reasons for visiting Pitawala Patana, and the recreational facilities/services that they hoped would be established for their enjoyment at Pitawala Patana in future. The average time taken for each interview was between ten and 15 minutes. The survey resulted in a total of 539 completed questionnaires.

Exploration of Economic Benefits Obtained by the Local Community

We conducted a community survey to identify the existing economic benefits enjoyed by local communities at Pitawala Patana. A team of tourism experts (consisting of academics, tourism practitioners, and social mobilizers) administered the survey. They used a pre-tested simple structured questionnaire in order to explore the economic benefits derived by the local community under the present scenario. The benefits enjoyed by the local communities were quantified under six subsections: guide services, accommodation provision, sale of crafts/local products, sale of local produce such as fruits and vegetables, sale of local foods, and cycle renting. A Likert Scale ranging from 1–5 assessed the local service providers' involvement under each subsection with the highest satisfaction level marked as 5 and the lowest satisfaction level marked as 1. The expert team filled the Likert Scale after conducting the community survey at Pitawala Patana.

Results and Discussion

Responsible Travel to Natural Areas

The questionnaire divided the reasons for visiting the Pitawala Patana reserve into four main categories for the purpose of assessing whether, and if so how, visitors to Pitawala Patana were engaged in what might be termed "responsible travel." Experts list bird watching, observation and appreciation of natural scenery, observation of wildlife, enjoyment of climate, and trekking under the category of more responsible travel. Experts classified bathing at Thelgamu Oya and relaxation in the natural environment under responsible travels to Pitawala Patana at the satisfactory level. Those who were visiting Pitawala Patana mainly as part of a trip and for get-togethers of family or friends were considered to be engaged in less responsible travel while those visitors who had little or no idea regarding the purpose of their visit were classified under not responsible travel to Pitawala Patana. Table 28.2 gives the percentages of traveling responsibilities according to which roughly 60.48 percent visitors were engaged in responsible travel to Pitawala Patana while 5.94 percent visitors were engaged in not responsible travels to Pitawala Patana.

Given that "more responsible" visits to Pitawala Patana are at 60.48 percent and "responsible visits at satisfactory level" are at 13.17 percent, it could be argued that the Pitawala Patana reserve fulfills the requirement for responsible travel listed under the definition for ecotourism.

Contribution to the Conservation of Environment

The contribution to the conservation of the environment at Pitawala Patana by the visitors is determined by visitor activities at the reserve. Hence, Table 28.3 gives the main visitor activities at Pitawala Patana. Table 28.3 which gives reasons for visiting Pitawala Patana shows that 24.86 percent (or 134) of the visitors came to the site to enjoy the existing unique landscape and

Table 28.2 Visitors' travel responsibility

Travel responsibility	Number of respondents	Respondents (percentage)
More responsible	326	60.48
Responsible at a satisfactory level	71	13.17
Less responsible	110	20.41
Not responsible	32	5.94

Table 28.3 Main visitor activities at Pitawala Patana

Activity	Preferred number of respondents	Preferred number of respondents (percentage)
More responsible		
i. Bird watching	59	10.94
ii. Appreciation of landscape	134	24.86
iii. Observation of wildlife	29	5.38
iv. Enjoyment of climate	81	15.02
v. Trekking	23	4.26
Responsible at a satisfactory level		
i. Bathing	89	16.51
ii. Resting/relaxing	21	3.89
Less responsible category		
i. As part of a trip	31	5.75
ii. Family/friends' get-together	12	2.22
iii. Drinking	28	5.19
Not responsible category		
i. No idea	32	5.93

16.51 percent (or 89) and 15.02 percent (or 81) for bathing and enjoying the climate, respectively. Around 10.94 percent (or 59) of visitors were interested in bird watching at Pitawala Patana. This shows that, overall, a majority of visitor activities were conservation-oriented as per the ecotourism definition except for bathing (16.51 percent), alcohol consumption (5.19 percent), and get-togethers (2.22 percent).

In ecotourism, nature education and nature-related conservation activities which have focused aim are considered as responsible activities, because these activities do not damage or disturb nature. Bathing and relaxation can be dome anywhere and without visiting Pitawala Patana, but those activities do not disturb or damage nature. There is no any focused aim to visit Pitawala Patana through the activities mentioned under the "less responsible category." Nature education and environmental protection are less priorities under the categories of "responsible at a satisfactory level" and "less responsible category." Therefore, those activities do not contribute to the conservation of the environment.

The conservation-oriented activities of the visitors, it could be argued, not only enable individual visitors to better appreciate the natural environment

but will also contribute toward shaping more environmentally friendly mindsets not only in those visiting but even those members of the community who are interested in investing in and deriving economic benefits from tourism-related ventures.

Contribution to Sustaining the Well-Being of Local Community

Table 28.4 gives the results on how the local community benefited from ecotourism at Pitawala Patana, which shows that the main benefit to the community came in the form of "guide work for local youth," sale of fruits and vegetables, and provision of accommodation to visitors.

Figure 28.1 gives the status of benefits to the community from ecotourism which indicates that, overall, only 21.30 percent of benefits were derived by the community from the visitors. It is also evident that under cycle renting, sale of local food, and sale of crafts/local products, the local community

Table 28.4 The status of benefits to local community from ecotourism

Opportunities	Community involvement	Requirement to be fulfilled
Guide services	46.40	53.60
Accommodation	22.80	77.20
Sale of crafts/local products	17.80	82.20
Sale of fruits and vegetables	24.20	75.80
Sale of local food	13.40	86.60
Cycle renting	3.20	96.80
Mean value	**21.30**	**78.70**

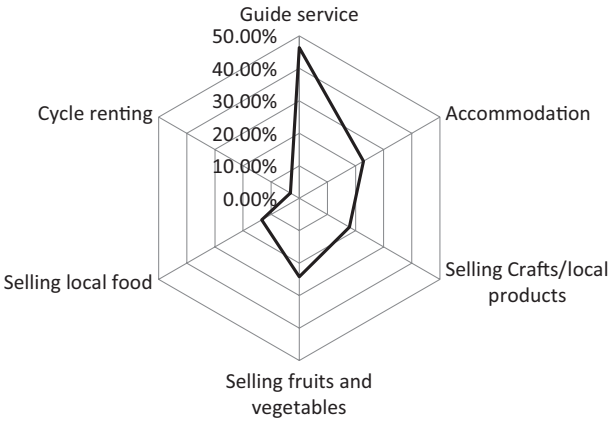
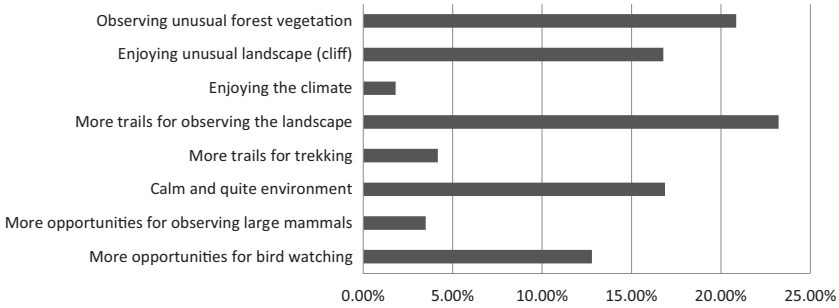


Fig. 28.1 The level of community participation in ecotourism at Pitawala Patana

derives fewer benefits. Hence, community involvement in the provision of the above services has to be improved and the community supported in efforts to get involved in the provision of the above services. Hence, it could be argued that the existing scenario at Pitawala Patana does not fulfill at a satisfactory level the aspect to ecotourism that speaks of sustenance of the well-being of the local community.

A question can be asked whether, based on the findings of the present study, ecotourism is sustainable at Pitawala Patana. Our findings suggest that while ecotourism at Pitawala Patana is sustainable up to a certain extend at present, local community involvement needs to be improved so that they obtain more benefits than they do at present. For instance, more interpretation facilities need to be established to make visitors aware of biodiversity and its importance, and why protected areas are important for conservation. At present, though most visitor activities are conservation-oriented, visitors have to be encouraged to become more consciously and conscientiously involved in conservation-oriented activities. Interpretation services is one way to do this, which the visitors too state in the visitor survey.

Figure 28.2 gives visitor preferences with regard to activities in the Pitawala Patana area. It shows 11.79 percent (or 52) of visitors to prefer more opportunities for bird watching while 2.49 percent (or 11) of visitors preferred to watch large animals. Of the rest, 15.87 percent (or 70) visitors preferred the calm and quiet environment; 3.17 percent (or 14) wished for more trails for hiking; 22.22 percent (or 98) wished for more trails for enjoying nature; 1.81 percent (or 8) liked the opportunity to enjoy the climate; 16.78 percent (or



	More opportunities for bird watching	More opportunities for observing large mammals	Calm and quite environment	More trails for trekking	More trails for observing the landscape	Enjoying the climate	Enjoying unusual landscape (cliff)	Observing unusual forest vegetation
Series1	12.79%	3.49%	16.87%	4.17%	23.22%	1.81%	16.78%	20.85%

Fig. 28.2 Preferences by visitors relating to enjoyment at Pitawala Patana

74) appreciated the unusual landscapes (cliff); 20.18 percent (or 89) liked the unusual forest patches/landscape; and 5.67 percent (or 25) saw it as part of a trip. The results indicate that highest in order of preference among visitors to Pitawala Patana were bird watching, calm and quiet environment, enjoyment of nature, enjoyment of unusual landscape (cliff), and enjoyment of unusual forest patches/landscapes of the area.

Preferences with regard to infrastructure/development by visitors to Pitawala Patana area are given in Fig. 28.3. It shows that 2.45 percent (or ten) of visitors preferred to have interpretive centers for nature education; 20.34 percent (or 83) preferred visitor centers for discussion; 12.5 percent (or 51) expressed a desire for brochures/trail guides; 3.43 percent (or 14) wished to have guide services; 21.56 percent (or 88) wanted self-guided nature trails; 1.47 percent (or six) expressed a preference for camping sites; 2.2 percent (or nine) wanted birds hides constructed; 15.19 percent (or 62) wanted wayside exhibits; 19.36 percent (or 81) mentioned clean toilet facilities; and 1.47 percent (or six) listed other items (such as facilities and places for resting, i.e., benches, and facilities for transport to the place). The results show a majority of visitors to prefer a visitor center for discussions, brochures/trail guides, self-guided nature trails, wayside exhibits, and viewing decks. Visitor activities at Pitawala Patana remain at present concentrated on walking along two nature trails, that is, Pitawala Patana trail (750 m) and Riverstern trail (1 km), but they will be diversified in future with the building of an additional trail between the two existing trails with links to the existing trails. Such a trail could be the start of more extensive long-distance hiking opportunities to be developed in the highlands in the foreseeable future by the Forest Department of Sri Lanka.

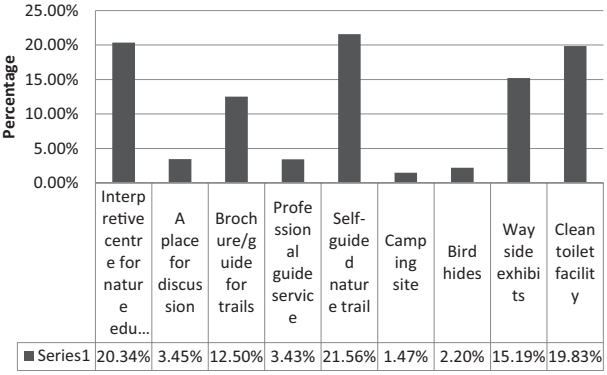


Fig. 28.3 Preference for infrastructure/development by visitors to Pitawala Patana

Pitawala Patana, it could be argued, has a unique potential in the park system for development of trekking due to the absence of elephants and the cooler weather. Heavy investment in interpretation services is warranted given the significance of the site in terms of biodiversity and visitor flows. Pitawala Patana is also home to many rare, endemic, and endangered species in all the major groups. Since little is known about many of these species, there is a great deal of potential to develop Pitawala Patana more as a site for science tourism, where scientists contribute their knowledge but also assist in revenue generation.

Taking into consideration the three criteria for ecotourism outlined above, that is, responsible travel to natural areas, contribution to environmental conservation, and sustenance of the well-being of the local people, it could be argued that the level of ecotourism operations at Pitawala Patana was not at a satisfactory level. The overall level of ecotourism operations at Pitawala Patana is at 52.54 percent which reveals a 47.46 percent deficit (Fig. 28.4) with optimum sustainability levels. There is an obvious need to improve the sustenance of the well-being of the local community aspect where that value at present is 21.30 percent.

One aspect of ecotourism development is the initiation of concessions which will add to the recreational opportunities and educational values available in the park while also providing a way to yield benefits to the local community. Concessions could employ organizations and workers, other than Forest Department personnel, in the provision of selected services within Pitawala Patana. These organizations may be community-based organizations (CBOs), non-government organizations (NGOs), members of the private sector, and/or a host of combinations from among these different groups. Park agencies throughout the world are increasingly turning to other service providers for assistance, allowing the agencies to concentrate more fully on

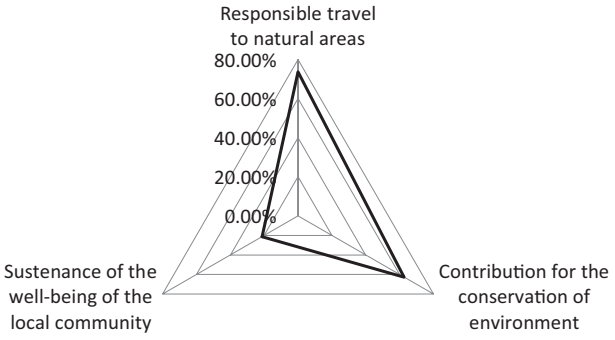


Fig. 28.4 Status of ecotourism operations at Pitawala Patana

their core role as conservation custodians rather than guides and facilities providers (Dearden et al. 2005). The government should therefore focus on drafting policies and enforcing the laws in order to ensure that the provision of ecotourism experiences does not compromise conservation principles and agendas.

Providing accommodation, selling crafts/local products, selling local produce such as fruits and vegetables, cycle renting and cycling opportunities, selling local food through cafeteria operations, and the provision of professional guiding services are the potential avenues for community involvement in concession development at Pitawala Patana. Cafeteria operations, maintenance of clean toilets, and ensuring a professional guiding service are common preferences of visitors to national parks everywhere. According to the results of the visitor survey to identify visitor characteristics and perceptions, a majority of visitors recommended the development and establishment of these visitor services and facilities at the forest reserve. The survey makes it obvious that visitors are not satisfied with the existing toilets and guiding services at the reserve.

According to Dearden et al. (2005), the government therefore is the conservation custodian and Forest Departments should encourage the service providers to operate concessions at national parks. Cycling as a recreational activity is growing strongly throughout the world. Pitawala Patana too is an excellent venue for cycling. Hence, it is suggested that a trial concession be developed in collaboration with the local community. However, identification of visitor characteristics, that is, the age groups of visitors and their perceptions on willingness to pay for tourism schemes, is also important when proposing ecotourism schemes for the study sites because, without such feasibility studies, tourism planning is bound to fail.

Lessons Learned

The local community at present is not very aware of the ecotourism potential of Pitawala Patana. The third requirement of ecotourism is sustaining the well-being of the local community. But the survey results show that the local community is willing to run income generation schemes in line with the ecotourism principle which would help with livelihood development and will lead in turn to the well-being of the local community. Though the local community, at present, does not benefit much from the existing initiatives, they are willing to derive more benefits from participation in and contributions to the whole notion of ecotourism. Hence, policy makers should take the

necessary policy decisions in order to ensure local community involvement and participation in ecotourism projects that would help with livelihood development. The findings show that the existing ecotourism potential is underutilized. They also show that ecotourism activities can be diversified to attract more visitors to Pitawala Patana.

Challenges and Barriers

The challenges/barriers to success in ecotourism operations can be discussed under two aspects, that is, underutilization of the ecotourism potential at Pitawala Patana and the dearth of opportunities at present to develop ecotourism concessions in order to get local community involvement in ecotourism development.

The National Forest Policy of Sri Lanka lays down the policy directions for forest management including tourism in protected areas (National Forest Policy 1995). There are adequate provisions in the policy for collaborative management of protected areas with the local community and the Forest Department and for benefit sharing. One of its objectives is "to enhance the contribution of forestry to the welfare of the rural population, and strengthen the national economy with special attention paid to equity in economic development."

However, the absence or deficiency in good communication channels is a challenge to ecotourism development in forest reserves. These communication gaps are evident not only between the government and private sector but also between various government institutions with each government institution working alone within its own territory. The chapter argues for the need to address this woeful situation, including a suggestion for the Forest Department to host the Ecotourism Forums annually and for Sri Lanka Tourism Development Authority to form a Multi-Sectoral Task Force on ecotourism.

Substantive changes are also needed in legislation, policies, and regulations. Perhaps the most fundamental change is one of attitude toward each other. The Lessons Learned section describes the roles of public and private sector in ecotourism. It is also a fact that the relationship between the Forest Department and local communities is often characterized by hostility, due to disputes over boundaries, encroachments, illegal use of resources and a general lack of understanding between the two parties. This has been the pattern in many parts of the world so that park agencies are now required by law to include local communities in their planning activities. In the case of Sri Lanka, the

main legislation is the Forest Ordinance although provisions for such collaboration are not clearly mentioned in it. But directions are given in the National Forest Policy.

The National Forest Policy of Sri Lanka (1995) also requires that local people be consulted in the process of decision-making, active participation in implementation, and in receiving direct benefits from the management of protected areas. The direct benefits could accrue to them through the promotion of visitor services and ecotourism at forest reserves. All activities within forest reserves administered by the Forest Department are legally bound by the Forest Ordinance. The Ordinance poses no legal impediments to the development of recreation concessions within the forest reserves as long as they have obtained prior clearance from the Department. Given the strong regulatory powers accorded the Forest Department by the Ordinance, there is strong legislative support for control of the activities of concessionaires were they to overstep the bounds of what is legally permissible.

Hence, a semi-structured questionnaire was administered for the purpose of obtaining the views of the local communities on ecotourism development and sustaining the well-being of the local community. Through the PRA techniques, the local community's perceptions on ecotourism and sustainability were elicited under the aspects of accommodation, sale of crafts/local products, cycle renting, sale of local food, and provision of guide services. The study was also able to identify the challenges facing such involvement of the community.

The Community Group for Providing Local Food Items

All members of the local community interviewed were in favor of ecotourism initiatives to attract more visitors to the area. They stated that their income would increase from the provision of local food items to visitors, such as fruits, jaggery, honey, and spices. However, the arrival of visitors to the area is seasonal which would lead to fluctuations in business prospects that could in turn pose a barrier for ecotourism development at Pitawala Patana. Seasonal ecotourism could also create competition within the community as regards business ventures. Though ecotourism encourages the production and sale of quality traditional arts and crafts, some visitors may not appreciate or place much emphasis on quality items, which may in turn lead to the sale of low-quality items at low prices. This would again drive a wedge between members of the community due to business rivalries.

The Community Group for Providing Accommodation

All members of the local community interviewed stated that they favor ecotourism initiatives and would like to attract more visitors to the area. They stated that they would provide accommodation to visitors to generate extra income. However, a majority of the tourists do not consider Pitawala Patana as their trip destination, considering it instead as a transit point, selecting Wasgamuwa National Park or Mahiyanganaya as their overnight accommodation stops. Further, local and foreign tourists visit the area only seasonally so that there are no visitors at all during some periods of the year. This would pose a challenge to those willing to provide overnight accommodation to augment personal income through ecotourism. However, during some periods there are no visitors. This would pose a barrier to augment local community income through sustainable initiatives.

The Community Group for Providing Professional Guide Services

All members of the local community interviewed were in favor of ecotourism initiatives to attract more visitors to the area. They stated that they could do so by providing guide services for a fee. An impediment to this aspiration is the practice of visitors who resort to online aids to find location and route, which preclude the need for guide services. Even were there to be a demand, it would be seasonal because, during some periods of the year, it is very difficult to travel to some locations in Pitawala Patana.

The Community Group for Providing Handicrafts

All members of the local community would like to attract more visitors to the area. They stated that they would supply handicrafts to the visitors to earn an income. However, the production cost for such endeavors is high, and it may be difficult to find raw materials from the area, which would pose a challenge to such endeavors.

The Community Group for Maintenance of Clean Restroom Facilities

All members of the local community interviewed were in favor of initiatives to attract more visitors to the area and stated that they will be able to maintain

clean restroom facilities for visitors to generate additional income. However, given the seasonal nature of travel to the area, there would be some periods of the year that would see no visitors which would make the income from the service fluctuate, denying the members of the community a steady income. Therefore, other infrastructure facilities and tourism schemes would need to be established to ensure a continuous stream of visitors throughout the year.

Establishing a suitable regulatory framework is key to ensuring that benefits are optimized and costs minimized. Hence, the Forest Department would need to pay attention, in particular, to the following issues in tandem with ecotourism concession development:

Licensing

– Will concessionaires have to obtain a license and how will they do so?
– Will there be conditions attached to the license, and if so, what would they be? It is strongly recommended that some form of the licensing system be developed which requires periodic renewal. This would allow the Forest Department to exert strong control over the concessions and for non-renewal of licenses of those who have not performed in a satisfactory manner. License contracts often outline the rights and responsibilities of each party and would include details on:

- Minimum or compulsory trading hours
- Standards for consumer service
- Environmental practices
- Pricing policy
- Public access to facilities
- Infrastructure maintenance responsibilities
- Signage of advertising
- Staff and operations accreditation standards
- Design of facilities

Revenue

– How much should be charged and who decides?
– Who will sell the tickets?
– How will revenue be shared between the park and the concessionaire?
– Who will pay for and maintain facilities? For concessionaires to become involved in service provision, there must be a financial inducement, that is, there must be ways for them to generate enough profits to recover costs.

Safety and Liability Issues

- Who will establish and monitor safety standards?
- Who will be responsible should an accident occur?
- Will the participating concessionaires sign a waiver on liability although lease arrangements might be useful in some circumstances (e.g., CBOs)?

Operations

- How will operations be monitored on a day-to-day basis? Although concessions will have formal reporting requirements (see below), provision must also be made to ensure that there is some regular contact with park staff to monitor day-to-day operations.

Reporting

- What will be the reporting requirements for the concessionaire? It is important to specify performance management targets for the concessionaires and ensure that these are independently monitored. The Forest Ordinance does not currently allow for the involvement of the private sector in many aspects of park management. Therefore, the Forest Ordinance needs to be revised to permit such public-private partnerships in the case of in national parks, in particular Pitawala Patana.

Concessions are contracts with the government that give the holder of the contract (the concessionaire) the right to provide services to tourists visiting protected areas. At the moment, such involvement is not allowed under the Forest Ordinance. A concessions policy is also required to create a framework for such agreements. A comprehensive concessions policy will be ought to be drafted by the Forest Department through a new policy on visitor services. The present study only considered the important clauses to be included in the Forest Ordinance in the making for ecotourism development in national parks. The study reviewed the clauses and provisions in the legislation based on the ecotourism principles.

Conclusions and Recommendations

A majority of the visitors who visited Pitawala Patana came from the nearby districts and belonged to the 41–50-year age group, their purpose for visiting the area being leisure. We were able to conclude from the survey results that

visitors found the area conducive for family tours, while a significant percentage of educated people were also among the surveyed visitors. In terms of gender, it was found that more male visitors came to the reserve while, in terms of socio-economic class, more middle-class Sri Lankans visited the area. With regard to employment, mostly government employees visited the area while visitors in general seemed to choose the area for tourism-related activities. The survey data also suggested that visitors in general favored the area for a single visit with most visitors seemingly choosing the area as a transit point in an onward-bound journey to other destination points.

Among the visitors were also those who chose the place for enjoyment of the natural landscape and climate and for hiking and bird watching. Pitawala Patana itself made this a highly desirable area to visit. The visitors preferred the place more for bird watching, for its calm and quiet environment, opportunity for enjoyment of nature, enjoyment of unusual landscape (cliff), and enjoyment of unusual forest patches/landscapes. Except for a few, a majority of the people who traveled to the area came there for environmentally friendly activities. Therefore, more opportunities should be created for these visitors to achieve their environmentally friendly objectives in visiting the place. Hence, according to the results, most visitors entertain and satisfy trip objectives that come under the ecotourism concept (i.e., responsible travel) at this destination. Hence, the activities do not compromise the conservation principle that underlies the declaration of Pitawala Patana as a forest reserve.

The visitors also preferred to have visitor centers for discussions, brochures/trail guides, self-guided nature trails, wayside exhibits, and viewing decks. They also preferred local youth from the area to be educated and trained as nature guides and accommodation in surrounding villages, walks through the villages, opportunities to experience traditional cultural items, and adequate sanitary facilities. The study showed the existing visitor activities and recreational schemes provided by the Forest Department to be conservation friendly and that they create minimum disturbance to the environment. As described under the second objective of the project, the purpose of responsible travel is to help conserve the environment and the present conditions for and purpose of visits by and large fulfills this objective.

Further Reading

Ashouri, P., and S. Fariyadi. 2010. Potential Assessment of Nature-Based Tourism Destinations Using MCA Techniques (Case Study: Lavasan-e Koochak). *Journal of Environmental Studies* 36 (55): 1.

Bambaradeniya, C.N., and S.P. Ekanayake. 2003. *A Guide to the Biodiversity of Knuckles Forest Region*. Sri Lanka: IUCN.

Bird, R., and B.T. Inman. 1968. *Income Opportunities for Rural Families from Outdoor Recreation Enterprises*, Agricultural Economic Report No. 68. Washington, DC: U.S. Department of Agriculture/Economic Research Service/Resource Development Economics Division.

Boo, E. 1990. *Ecotourism: The Potentials and Pitfalls*. Vol. 1 and 2. Washington, DC: World Wildlife Fund.

Boyd, S.W., and R.W. Butler. 1996. Managing Ecotourism: An Opportunity Spectrum Approach. *Tourism Management* 17 (8): 557–566.

Buckley, R. 1994. A Framework for Ecotourism. *Annals of Tourism Research* 21 (3): 661–669.

Budowski, G. 1977. Tourism and Conservation: Conflict, Coexistence or Symbiosis? *Parks* 3–6: 1.

Ceballos-Lascurain, H. 1987. The Future of Ecotourism. *Mexico Journal* 1: 1.

Central Environmental Authority (CEA). 2007. *National Enviromental Act*. Sri Jayawardenepura Kotte: Central Environmental Authority.

Dearden, P., M. Bennett, and J. Johnstone. 2005. Trends in Global Protected Area Governance, 1992–2002. *Environmental Management* 36 (1): 89–100.

Eagles, P.F.J. 1997. *International Ecotourism Management: Using Australia and Africa as Case Studies*. Paper Prepared for the IUCN World Commission on Protected Areas, Protected Areas in the 21st Century: From Islands to Networks.

Elper Wood, M. 2002. *Ecotourism: Principles, Practices and Policies for Sustainability*. New York: United Nations Publications.

Forest Department. 1995. *National Forest Policy*. Rajamalwatte, Sri Lanka: Forest Department.

Heintzman, P. 1999. Spiritual Wellness: Theoretical Links and Leisure. *Journal of Leisurability Ontario* 26: 21–32.

Herath, G. 1996. Ecotourism Development in Australia. *Annals of Tourism Research. Research Notes and Reports* 23 (2): 442–446.

Linberg, K., J. Enriquez, and K. Sproule. 1996. Ecotourism Questioned: Case Studies from Belize. *Annals of Tourism Research* 23 (3): 543–562.

Mandziuk, G.W. 1995. Ecotourism: A Marriage of Conservation & Capitalism. *Plan Canada* 35: 29–33.

Mathieson, A., and G. Wall. 1982. *Tourism: Economic, Physical, and Social Impacts*. First ed. England: Longman Group Limited.

Moore, S., and B. Carter. 1993. Ecotourism in the 21st Century. *Tourism Management* 14 (2): 123–130.

Nelson, J.G. 1994. The Spread of Ecotourism: Some Planning Implications. *Environmental Conservation* 21 (3): 248–255.

Orams, M.B. 1995. Towards a More Desirable Form of Ecotourism. *Tourism Management* 16 (1): 3–8.

Sri Lanka Tourist Board (SLTB). 2003. *Ecotourism Development Strategy of Sri Lanka*. Sri Lanka: Sri Lanka Tourist Board.

Wickramasinghe, K., P. Steele, and A. Senarathne. 2006. *Impact of Forest Conservation on Household Economy and Poverty: Case of Knuckles National Wilderness Heritage (NWH) of Sri Lanka*. Colombo: Institute of Policy Studies of Sri Lanka.

Wight, P.A. 1993. Improved Business Positioning: Environmentally Responsible Marketing of Ecotourism. In *Expanding Responsibilities: A Blueprint for the Travel Industry.* Proceedings of the 24th TTRA Conference, Whistler, British Columbia, 200–207, Travel and Tourism Research Association, Wheat Ridge, CO. June 13–16.

Yamane, T. 1967. *Elementary Sampling Theory*. Englewood Cliffs: Prentice Hall.

29

Green Building and Sustainability: Diffusing Green Building Approaches in the UK and Germany

Kirstie O'Neill and David Gibbs

Background

Concerns over the need to reduce energy consumption, greenhouse gas emissions, and resource use are increasingly encouraging a focus upon the building sector, given that buildings represent a major share of emissions and energy use while also potentially representing one of the most cost-effective and significant opportunities to achieve such reductions. Moreover, a shift toward a "green" building sector is also seen as a means to deliver new jobs, growth, and improved business competitiveness (Aldersgate Group 2011). In this chapter, we examine the development of the green building sector in the UK and Germany and explore how the contingent political, economic, and social contexts of both countries have influenced green building policies. We outline the main legislative drivers in both countries for green building, before highlighting the effects of these in facilitating or constraining the green building sector. We draw on qualitative research with 55 green building entrepreneurs and policy makers in the UK and 24 interviews in Germany (Gibbs and O'Neill

K. O'Neill (✉)
Department of Geography and Environment, London School of Economics and Political Science, London, UK

D. Gibbs
Department of Geography, School of Environmental Sciences, University of Hull, Hull, UK

R. Brinkmann, S. J. Garren (eds.), *The Palgrave Handbook of Sustainability*,
https://doi.org/10.1007/978-3-319-71389-2_29

2014; O'Neill and Gibbs 2014). This provided the opportunity to compare experiences and practices, as well as assess the potential of these to offer lessons for future policy development.

The Policy Context for Green Building

The European Commission and United Nations have identified construction and housing as priority areas for action on carbon emissions (UNEP 2016; Vickers and Vaze 2009; CBI 2007; European Commission 2011). The building sector is a significant contributor to greenhouse gas emissions (GHGs)—at the European level, the building sector accounts for 42 percent of the final energy consumption and about 35 percent of all GHGs (Deutsche Bank 2010). In the UK, the Royal Institute of Chartered Surveyors estimates that the built environment accounts for 25–40 percent of energy use globally, 30 percent of raw material use, 30–40 percent of greenhouse gas emissions, and 30–40 percent of solid waste generation (Hartenberger 2011). Housing accounts for around 30 percent of energy consumption and 27 percent of national carbon dioxide emissions (cf. Mason 2013; DECC 2011). Globally, these figures are set to increase as a result of population growth and increasing demand for buildings in developing countries (UNEP 2016). UK housing is some of the poorest performing within Europe in terms of energy efficiency, offering potential for significant savings in energy use and thus carbon (and other pollutant) emission reductions. Despite the advances made in green building in Germany, German housing has similar levels of CO_2 emissions per capita to the UK and a parallel policy trajectory for emission reductions of 40 percent by 2020 and 80 percent by 2050 (McLeod et al. 2012). In developed countries, where rates of new build are low compared to the stock of existing buildings, retrofitting buildings is a major component of achieving carbon reduction targets (Owen et al. 2014; Hodson et al. 2016). In the UK, it is estimated that around 75–80 percent of the UK's 2050 building stock already exists (SDC 2006); any low carbon transition will therefore have to encompass both green new build and retrofitting.

Many of today's ideas and approaches for green building stem from the 1970s appropriate technology (AT) movements. In Germany, as well as the UK, these social movements took radical approaches to the development of technology, with housing forming a particular focus for action (Smith 2006). At the outset, these AT activists and their approaches were viewed as quirky; however, their innovations are now becoming associated with mainstream thinking on green building and gaining increasing attention from policy

makers. Both Germany and the UK have had similar directions of green building development, linked to the emergence of AT and concerns over the environmental impacts of conventional development. However, in Germany there may be other underlying reasons for the adoption of some ATs and practices, beyond concerns about environmental change and energy security (Mössner and Freytag 2013). For example, the 1970s Organization of the Petroleum Exporting Countries (OPEC) oil embargo stimulated the growth of renewable energy, including the emergence of a solar electricity industry, stimulating government and business interest (Hinrichs 2014). By contrast, the discovery of abundant oil and gas in the North Sea tied the UK more firmly into a carbon-based energy system. Mössner and Freytag (2013) also argue that traditional concerns over economic development in Germany overlapped with concerns about the development of nuclear energy, thus resulting in a dual-focused coalition against the nuclear sector. Therefore, while many attribute developments in the 1970s to radical social change and movements concerned about resource *consumption*, in Germany there was also a parallel discourse of resource *scarcity* that prompted the requirement for alternatives. More recently, in both countries, climate change is providing a stimulus for changing practices and consumption.

Case Studies: Green Building in the UK and Germany

Green Building in the UK

In the UK, the built environment has become a key focus of regulatory intervention aimed at cutting carbon emissions (Fischer and Guy 2009). The UK Government announced the need for a rapid transition to zero-carbon new building in December 2006 as a key step in reducing GHGs from the domestic and non-domestic sectors (DCLG 2006a; Weaver 2006; McLeod et al. 2012). The original definition of zero-carbon homes (ZCH) was established in the UK in December 2006 when the Code for Sustainable Homes (CSH) was introduced as a voluntary six-tiered sustainability rating system leading to Code Level 6 or a zero-carbon home (DCLG 2006b; Gibbs and O'Neill 2015). Through these measures, the UK Government proposed meeting the European Commission's Nearly Zero-Energy Building (NZEB) requirement under the Energy Performance of Buildings Directive (EPBD 2010/31/EU), which requires all new buildings constructed in the European Union from

2021 to be nearly zero-energy buildings.[1] In 2015 the CSH was withdrawn, albeit that the UK remains committed to the EU target (Greenwood et al. 2016), although this is just one policy area that may be affected by the UK's recent decision to leave the European Union. The CSH concentrated purely on new build housing—no equivalents exist for retrofitting, nor are there currently UK energy performance standards that make detailed reference to the embodied energy or carbon emissions from a building (McLeod et al. 2012). Despite the policy focus on new builds, Galvin (2010, 836) argues that due to the materials required for new buildings "even if a new building uses hardly any energy over its lifetime, it still takes 25–50 years before it starts to pay its way in comparison to an old building modestly renovated so as to reduce its emissions by 1 or 2 tonnes of CO_2 per year." In terms of retrofitting existing properties, arguably a greater challenge, the UK Government created three financial frameworks to encourage investment in low-carbon technologies and refurbishment of buildings—Feed-In Tariffs (FITs), the Green Deal, and the Renewable Heat Incentive[2] (RHI) (Tweed 2013); the FITs have since been abolished and were thus rather short-lived, and the parameters of the Renewable Heat Incentive have changed following a government consultation in 2016. Like the Green Investment Bank, the Green Deal has recently been sold off to a private company, changing from a public policy to a private finance institution. The Green Deal aimed to facilitate mass thermal renovation through financing renovation projects in rental and owner-occupied homes (Galvin and Sunikka-Blank 2013) and was a voluntary financial incentive, supported by private sector annual investments of £7 billion. Householders could apply for a property-attached loan to install energy efficiency measures—a key pillar of this policy was its so-called golden rule, in which monthly fuel consumption savings would cover the loan repayments.

Carbon emissions in UK buildings are also dealt with by Building Regulations, where Part L relates to energy efficiency and consumption (Fischer and Guy 2009). Part L sets the minimum level required in order to meet building regulations and deals with specific building elements. By contrast, the CSH encouraged the consideration of issues beyond energy consumption and a holistic, whole-building approach (Gibbs and O'Neill 2015). Under Part L, developers are required to achieve energy performance targets set through a National Calculation Methodology and to demonstrate that their buildings will meet those targets (McManus et al. 2010). The targets are expressed in terms of a Target Emissions Rate (TER) in kilograms of carbon dioxide per square meter per year ($kgCO_2/m^2$ yr) and an energy demand target in kilowatt-hours per square meter per year (kWh/m^2 yr). Part L covers performance levels for the overall building and allows designers to offset weak

performance in one element of the building with better performance elsewhere (Raman and Shove 2000). Frequent revisions (most recently in 2016) of the Building Regulations have been confusing and time-consuming for all involved in building processes (Fischer and Guy 2009). Part L of the Building Regulations is now the only statutory means for reducing the environmental impact of housing in the UK and does not go as far as the CSH previously did. This means that, in reality, going beyond the requirements of UK building regulations is purely voluntary—whereas Level 6 of the CSH was to become mandatory from 2016, the revised Building Regulations now work to Code Level 4.

During the time in which the UK's CSH was operational, the government changed the definition of ZCH (McLeod et al. 2012). The original definition stated that net CO_2 emissions from all energy used in the dwelling as well as net CO_2 emissions from use of appliances in the homes should be zero or better (averaged over a year) (DCLG 2006b). At the time, the Renewable Advisory Board (2007, since disbanded) advised that the ZCH policy should "minimize the use of remote offsite energy generation in meeting zero carbon standards e.g. by setting a tight cap on its use and a high 'buy-out' cost for any offsite generation fund" (BERR 2007, 24). Despite this, the zero-carbon definition was revised (HM Treasury 2011), and so-called Allowable Solutions (Fig. 29.1) were introduced in law in 2014 (since scrapped in 2015), which effectively contradicted the Board's original advice. McLeod et al. (2012) argue that changing definitions have effectively watered down the key energy efficiency parameters required to achieve a zero-carbon dwelling, compared to the original definition. They also argue that even if the ZCH recommendations had been implemented, many of the UK's future so-called zero-carbon dwellings may have performed little better than buildings that simply comply with the legal minimum standards. This is unlikely to improve given the political changes consequent upon the election of a Conservative government in 2015.

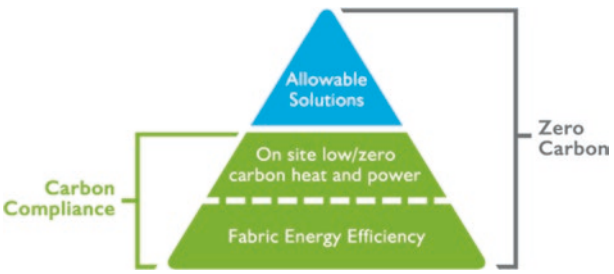


Fig. 29.1 Allowable Solutions for meeting ZCH requirements (Source: Zero Carbon Hub website. Accessed 15 August 2014)

They question why very low-energy building designs (such as the Passivhaus standard or PlusEnergy Homes[3]) are not being encouraged through UK housing policies. However, this assumes energy is the most pressing concern and ignores the wider issues that many green builders are concerned about such as resource sustainability, occupant health, and low use of hazardous materials.

Under the Allowable Solutions, developers had the option to invest in offsite renewable energy generation, rather than providing onsite generation, effectively a form of carbon offsetting. At the time, critics questioned how the Allowable Solutions would have worked, including the length of time such Allowable Solutions would operate in relation to the emissions they were supposedly offsetting. For the UK building sector, the introduction of Allowable Solutions effectively introduced a buyout clause. As with most forms of carbon offsetting, the system would have been inherently complex to implement and monitor (Kill et al. 2010), and there is a growing body of evidence suggesting that carbon trading and offsetting does not lead to emission reductions (McLeod et al. 2012). Despite this, Stephen Williams[4] announced that the UK Government had decided that developer choice should be paramount—"developers will be free to decide how they use the Allowable Solutions scheme."[5] The rationale for this, according to the Department for Communities and Local Government (DCLG), was that: "if the definition of zero carbon is too rigid (such as requiring all renewable energy to be onsite) or too costly, it could potentially prejudice smaller urban brownfield developments in favor of larger greenfield sites [as they] offer greater economies of scale in energy supply technologies" (DCLG 2008). Such comments illustrate a lack of ambition in UK policy and the role it could potentially play in engendering a low carbon transition. Examples of buildings, such as Passivhaus and PlusEnergy Homes, which produce their own power and require very little power to heat them already exist, yet have been neglected in UK policies. Evidence that such challenges can be coherently addressed on a large scale is documented in the European Energy Cities project, where case studies of successfully implemented large-scale zero-carbon developments include Kronsberg (Hanover) with 6000 Passivhaus dwellings proposed for 15,000 people relying mainly on solar and wind energy, and the Vauban district of Freiburg, located on a former French barrack site with all buildings meeting the Passivhaus standard (Mössner 2015; Energy cities[6]). Thus, while the then labor government initially sought to achieve carbon emission reductions through a set of comprehensive policies for the building sector, this lacked consistency and been subject to frequent amendments and abolition by subsequent administrations in favor of the dominant building regime (Lafferty and Hovden 2010), as well as a preference for economic growth.

Green Building in Germany

Like the UK, Germany has a policy of reducing GHGs by 80 percent by 2050 compared with 1990 levels (BMU 2007). As elsewhere in the EU, there is increasing interest in thermally renovating existing housing stock so as to save heating energy and reduce GHGs (Tuominen et al. 2012, in Galvin and Sunikka-Blank 2013). Building is one of the biggest and most important sectors in Germany, and its economic and ecological potential is considerable, according to the Building for the Future (ZukunftBau) initiative (BVBS 2010). This initiative involves the Federal Government investing in new and innovative building approaches and materials and thus using its own construction projects to set examples of green or sustainable building methods. The Government therefore sees itself as integral to promoting exemplary, modern, and innovative buildings. For the Federal Government, sustainable building is defined as:

> *…reducing land use, minimising energy consumption in construction and operation of the building, meeting the requirements of future generations by ensuring the longest possible service life and relying on regenerative raw materials for building purposes*. (BVBS 2010, 15)

The German Government introduced a certification scheme for its own buildings in advance of the creation of the Deutsches Gesellschaft für Nachhaltiges Bauen (DGNB—German Green Building Council) certification scheme in 2009. In addition, at the local level, Passivhaus standards have been incorporated in some German cities for public buildings (e.g., Frankfurt). In Germany, there are additional measures that promote varying degrees of green building. The Kreditanstalt für Wiederaufbau (KfW Bank), a government-owned green bank, finances green buildings, particularly through funding support for "Die Energieeinsparverordnung" (EnEV, or The Energy Conservation Law) (2009, revised 2016). Loans of up to €50,000 are provided toward the cost of a new low-energy dwelling (known as an Effizienzhaus[7]) and up to €75,000 toward the cost of refurbishment. The interest rate of the loan is significantly less than a standard high street loan, and in addition, a grant is available depending on the energy efficiency level that the dwelling achieves (Cutland 2012). In addition to the support available from the KfW, grants are also available at the local, regional, and state level for Passivhaus buildings (Cutland 2012). This contrasts with the UK, where no similar support is available and where the Green Investment Bank (which the UK Government recently sold to the Macquarie Group and is now a private

institution) predominantly funded large-scale infrastructure projects.[8] German thermal renovation standards are set out in the Energy Conservation Law (EnEV). In 2002, compulsory thermal standards for retrofits were introduced under the EnEV—whenever 20 percent or more of a house (e.g., wall or roof) was being repaired or renewed, that entire feature had to be thermally renovated to the same standard as a new build. Despite this, Galvin (2010) notes that crucially the EnEV targets primarily new builds, not renovations. The EnEV standards are driven by the government's commitment to reduce energy consumption in buildings, but are also negotiated with the construction industry to take account of its current and future capabilities, so that optimally energy-efficient new buildings are also economically viable (Galvin 2010). Furthermore, there are Federal Government guidelines for green roofs, as well as various taxes, grants, and incentives at a range of geographical scales. These laws have provided an inspiration for other countries' legislation on, for example, Feed-in-Tariffs and energy-saving standards. The European Energy Performance of Buildings Directive (2010/31/EU) also applies in Germany, although Galvin and Sunikka-Blank (2013) indicate that specifications for the "nearly zero-energy" standard still have to be defined at national level.

At first sight then, it would appear that Germany has experienced a more consistent and comprehensive policy approach to green buildings. However, despite these regulations and laws applicable to green or sustainable building, how well do policy makers and businesses feel that this is enabling good practice to diffuse or translate to other contexts regionally, nationally, and internationally? In the following sections, we explore our empirical material by concentrating on the diffusion of building practices in the national contexts of the UK and Germany and the ways that key actors in the green building sector are central (or not) to such diffusion.

Lessons Learned

In our research, we have drawn upon a body of work within social studies of technology concerned with the transformation of socio-technological regimes, which emphasizes the role of innovative (technological) niches in effecting transitions toward sustainability (Smith 2003; Geels 2005; Grin et al. 2010). In this work, such niches, in this case the green building sector, are defined as small-scale learning spaces for new technologies, comprising either a single experiment or project or clusters of several experiments (Kemp et al. 1998), offering protection and functioning as test-beds for new technologies and ways of working in the building and construction industry. Breakthroughs

and tipping points may be reached as a result of niche innovations creating momentum for change, as well as bottlenecks in the mainstream regime (i.e., the building and construction sector) or pressures at the wider societal level (e.g., rising fuel bills and climate change). If the policy and political contexts are supportive, opportunities may open up for niche innovations to become mainstreamed (Schot and Geels 2008). Key actors within the niche may facilitate such breakthroughs by acting as change agents.

Learning and sharing experiences are core elements of the processes of upscaling, diffusing, and translating niche innovations, as is networking. The actions that niche actors take to disseminate niche practices are related to the success (or not) of niche innovation expansion. Learning activities can involve learning by doing, learning by interacting, and learning by using (Geels 2002) and are most effective when contributing not only to everyday knowledge and expertise but also through second-order learning where people question the assumptions and constraints of existing ways of operating in sectors such as building and construction (Kemp et al. 1998). As Darby (2006) suggests, learning can be viewed as an experiential cumulative acquisition of tacit knowledge—for example, residential green buildings may be an important vehicle for higher-order learning about energy conservation at a societal scale (see also Marres 2013; Preller et al. 2017). In our UK research, a number of respondents providing buildings for green holidays suggested that their buildings offered such an opportunity for visitors to learn about green buildings and green living, as an experiential space as a precursor to perhaps implementing green building methods in their own lives.

In Germany, the 1975–6 civil campaign against the planned nuclear power station in Wyhl, near Freiburg, triggered a new approach to building, energy use, and social living practices (Doyle 2005; Mössner 2015; Fastenrath and Braun 2016), leading to Freiburg becoming a hotbed of such innovations. Key examples of green building in the area, such as the Sun Ship and Solar Settlement[9] (designed and built by the Freiburg-based architect Rolf Disch), were flagship examples of what could be achieved and led to both experimentation and learning. In this manner, learning may be seen as a mechanism for policy change (Nilsson and Persson 2003).

Networking is an allied process of sharing information—by embracing different stakeholders and partners, niches can benefit from resources and support from a wide range of organizations. Such activities can help niche learning dissemination and reinforce the lessons learned from local projects (Geels and Raven 2006). Several examples of learning and networking mechanisms were evident in Germany, for example, the Ministry of Transport, Building, and Urban Development developed a PlusEnergy House in Berlin where a family

of four live (the house also powers electric vehicles) and all the technologies are being monitored—the building is a home, a research object, and show location. In addition, networks such as Öko-bau Rheinland (Eco-Building Rhineland) are established to bring together like-minded businesses that build, supply, and use eco- or natural building materials. Network members offer training sessions to other members, as well as the wider business sector, to disseminate knowledge about both their businesses and natural building materials and to attempt to change practices.

These mechanisms of best practice sharing and policy mobility were not always straightforward or successful. For example, a Freiburg architect described some of the problems associated with transferring learning from one regional context to another:

> *…every once in a while I get a phone call, normally from some [Middle Eastern] country, someone saying 'oh I want this'. And of course it doesn't work. This is for our climate. It does not make sense at all to have this kind of structure somewhere in the Saudi Arabian desert. And they get disappointed…* (Interview with Architect)

This is particularly interesting, as Freiburg has positioned itself as a center of excellence for green building, low-energy design, and a major destination for people wanting to learn about such methods. However, in practice such translation is not necessarily straightforward and frequently requires adaptation—"ecologically oriented building is not a fixed concept that can be applied to any construction project in the same way."[10] Nevertheless, practices *have* to be diffused, given that climate change is a problem that does not just apply to one city or region but requires approaches that take a more global vision:

> *…if you could change the world by only doing things in Freiberg [our firm] probably would do that. But of course, you can't do it. And as for the CO_2 it doesn't matter if you save it here or if you save it in China…* (Interview with Architect)

While definitions of zero-carbon and low-carbon building in the UK have been contested and subject to legislative changes, in Germany, despite their advanced sustainable building sector, there was a feeling that concepts such as low-energy consumption buildings are also lacking and this is creating tension for builders. One architect suggested that Passivhaus standards should form part of the definition:

> *From 2020, at least that's what [the EC] say. Every new building in Europe should be very, very, very low energy in consumption, whatever that means. It has not really*

been defined [there are] 20 pages saying nothing…it should actually be something like Passivhaus standard. (Interview with Architect)

Defining such concepts is part of a process necessary to ensure learning and experimentation can continue toward agreed goals. While Smith (2006) argues that form follows environment, this approach suggests that form may be better following energy (cf. Disch, undated). Beyond what Smith (2006) describes as voluntarily over-complying with the regulations in search of sustainable development, some of the innovators involved in our research have been setting the benchmark, and regulations and legislation have subsequently followed their innovatory work. Even though Germany has been building and experimenting with buildings like Passivhaus and PlusEnergy Houses for over 25 years, it was the view of one architect that many other European countries were lagging behind and that German experience had not been widely diffused, which would make it difficult to meet the European legislation on nearly zero-energy buildings by 2020:

…this is what we've been doing for 25 years now and now we have this [EU legislation]. I doubt that we would actually see that happening in 2020 because there are many countries in Europe where you don't have a single Passivhaus as yet. (Interview with Architect)

For this architect, there is now a need to move beyond pilot projects since "the technical problems, all the planning problems, have been solved"; what is needed now "is if the little town or a village has a new housing estate project you do that in PlusEnergy. You have to do the big things now." Such big things are not so easily adopted by existing regulatory regimes, which are set up to deal with accepted designs and processes and which adopt new ideas slowly. This is particularly relevant in the UK where the planning system represents one of the biggest hurdles for those wanting to build green buildings (Seyfang 2010). While McLeod et al. (2012) and Tofield (2012) argue that the Passivhaus standard is the only energy efficiency standard capable of delivering long-term reductions in space heating, cooling, and hot water energy consumption, such ambitious standards appear to be contentious in some contexts. It is not only in the UK where Passivhaus has not substantially penetrated building practices—one architect in the Cologne region described how "even over 5–6 years [there has not been a] material increase in the number of architects doing Passivhaus." As a means of learning about Passivhaus and creating demand, he sends new clients to existing Passivhaus projects to show them what is possible "the owners of the houses are proud and want to

show off…so are happy to receive visitors." Certification schemes are also part of the process of defining and agreeing on problems and solutions for transitioning toward sustainability, although they have been critiqued for encouraging a tick-box mentality rather than holistic design principles (see Boschmann and Gabriel 2013, for instance). In contrast to the general view of Germany as a leading country, in developing a certification scheme for sustainable buildings, Germany developed relatively late. As the director of one such scheme described:

> *In 2005 there were investors coming from UK and US and they brought their own certification systems…the German architects and designers they felt that those systems don't really fit the needs of the German buildings and the technologies and the design philosophy and that is why we decided to do our own certification system…* (Interview with Certification Organization)

As the interviewee indicates, translating schemes from other countries is not necessarily easy or helpful. However, having rules and regulations was criticized by some German respondents as stifling creativity and innovation, politically, technologically, and socially. One German policy maker described how "in Germany [we have] enough codes and standards already, that is why we never had a certification scheme before because people thought we had so many regulations in Germany and then you do a certification scheme on top, [it] is too much." Despite this, investors were reported as demanding a scheme that would give them a quality seal.

By comparison, the UK's post-2015 approach to green building relies on minimal standards being met rather than pushing the boundaries to reach higher levels of sustainable building. Reliance on Building Regulations and in particular Part L to encourage more sustainable, low-carbon buildings appears to have encouraged the building industry only to work to the minimum required. As one green builder involved in our research commented:

> *sometimes you'd struggle to say "well, is this sustainable", because it's clearly not; it's a compromise; I think that's what we've always said. We'll try to do it slightly better than it's been done before, we're doing it often in excess of what's expected of us, say, in terms of Building Regulations or whatever. And again, that's always been our kind of ethos, we work beyond that, you know…the building industry works to the minimum not the maximum – Building Regs are minimum, as soon as they hear that, they stop. Our ethos was to…ignore that and see how much we can get into a building and still make it viable.* (Interview, Green building company)

In contrast to Germany, in the UK, some green builders lamented the time taken for product testing and certification of new materials and innovations. For a UK green materials supplier, "the products that we've got now are all tested and certificated, they've got technical approval in Germany," but this is not necessarily transferable to the UK context, for example, in terms of insurance as "people like Premier and NHBC[11] who are again very big insurers in terms of construction, Premier will accept our products; NHBC won't because it's not certificated by a particular organization here…." Another green builder talked similarly about triple glazed, well-insulated windows which have been available in countries like Sweden and Germany for "the last thirty years or so," but in the UK, "it's taken almost 'til the last couple of years for window manufacturers to say right, well we've got to – not imitate it – but come up with something similar,[12] similar ways of building because that is, that's what people want, and also it makes sense." However, in niches such as straw bale building methods, builders in both the UK and Germany recognized the UK's leading role—a German green builder had been to the UK to learn about straw bale building, while a UK straw bale builder reflected that while Germany is a leader in many green building approaches, "they're certainly not in straw bale building, and they're very limited because…they're really quite over the top with their details…which you know is a positive and a negative. So, it's positive in that you get high quality houses built and it's negative in that it's very, very hard to do anything that's new or different…they can't do load-bearing…they could be pushing the boundaries but they like to stay within the rules." Similarly, natural building promoters in the Cologne region stated that Germany has a very conservative attitude toward adopting new building methods and designs. As Smith and Stirling (2007) argue in relation to the diffusion of clean tech, overarching structures of design criteria and routines, markets, final consumer demand, institutional and regulatory systems, and inadequate infrastructures for change can limit diffusion or indeed encourage it—much the same can be said with respect to green building. Crucially, sustainability will not be reached by technology alone; learning by policy makers, individuals, professional societies, and other institutions is central to this process of transition (Brown and Vergragt 2008), as well as a shift in practices (cf. Shove 2003). There is therefore a need for "learning between actors in the policy network leading to changes in sector policy-making processes and outputs as a result of new mandates of environmental concerns and knowledge about environmental consequences" (Nilsson and Persson 2003, 340).

Challenges and Barriers

There are a range of measures, from funding schemes to policy frameworks, that promote green buildings in Germany, at a variety of geographical scales, many of which stemmed from early experiments and pilot projects. As discussed above, while the UK initially introduced a raft of policy measures aimed at both encouraging a green building sector and linking this with wider policies for a low-carbon economy, these were subsequently watered down or abandoned altogether. Indeed, UK zero-carbon housing policy has been plagued by disagreement and inconsistency,[13] and this has been criticized by both niche and mainstream actors in the building industry for creating policy uncertainty and additional costs (Greenwood et al. 2016). The need for consistency of policies is a key lesson to be learned from the UK evidence. However, despite the views of our UK respondents that Germany is an easier place for green building developments, our research suggests that green building in (parts of) Germany is still largely a niche sector, albeit with the potential to be mainstreamed (Deutsche Bank 2010). Many German interview respondents lamented that politically the country is quite conservative, which has inhibited the implementation of measures, which could have significant potential for improving sustainable building. Indeed, German respondents reported challenges, such as consumer concerns, cost differentials between green and conventional building, prejudices, and lack of support from policy makers and politicians as inhibiting further advances.

While green building companies in the UK look to learn lessons from Germany as an example of green building success, in Germany many businesses reported that there were still hurdles to be overcome. Despite this, there was certainly a sense of normalization (or progression from being a niche to the mainstream) for some green architects in Germany by comparison with the UK where green building remains very much a niche activity. They suggest that now there is more awareness and comprehension—as green or sustainable building methods and materials become more visible, more people are interested and understand what is involved. In this chapter, we have highlighted the unevenness of learning from, and experimentation with, green building, as well as the limitations to translation. We have shown how a number of key actors are leading the way in terms of innovation and experimentation, and that policy measures can support or hinder such developments. Policy measures and associated programs of support and incentives in both the UK and Germany need to encourage the diffusion of

green building as a core means of tackling anthropogenic GHG emissions; this is an urgent action, and one that our respondents do not see happening quickly enough.

Notes

1. The EPBD is the main legislative instrument, at the European level, for improving the energy efficiency of buildings. A key element of the EPBD is its requirement for Nearly Zero-Energy Buildings (NZEB). According to the EU, a nearly zero-energy building means a building that has a very high-energy performance. The nearly zero or very low amount of energy required should be covered to a significant extent by energy from renewable sources, including energy from renewable sources produced on-site or nearby. http://www.zerocarbonhub.org/sites/default/files/resources/reports/ZCHomes_Nearly_Zero_Energy_Buildings.pdf (accessed 2 October 2014).
2. The Feed-in-Tariff and the Renewable Heat Incentive provided financial support to those installing renewable energies domestically for the generation of electricity and heat (e.g., solar PV or ground heat source pumps). The Green Deal provided loans for households installing a range of energy efficiency measures. The first round of changes to the Renewable Heat Incentive is due to come into force on 20 September 2017 and affect the incentives for different types of renewable technologies.
3. Although Passivhaus and PlusEnergy Homes are propriety design concepts rather than toolkits or guidelines for low-carbon low-energy building.
4. Parliamentary Under Secretary of State for Communities and Local Government.
5. https://www.gov.uk/government/speeches/speech-to-the-zero-carbon-hub.
6. http://www.energy-cities.eu/ (accessed 12 September 2014).
7. An Effizienzhaus is one that requires less energy than new builds which meet building regulations, at specified percentage savings—so, an Effizienzhaus-70 required 30 percent less than a new build which requires 100 percent.
8. See http://greeninvestmentgroup.com.
9. The Sonnenschiff and Solarsiedlung in Freiburg are PlusEnergy buildings with residential and commercial spaces.
10. http://www.sueddeutsche.de/geld/oekologisch-bauen-babylonische-bauverwirrung-1.286335 (accessed 21 August 2014).
11. National House Builders' Council.
12. However, many products developed often emphasize energy consumption, rather than the sustainability of the materials used. For instance, in relation to windows, many UK windows still use uPVC (a harmful material) despite being more energy efficient.
13. http://www.theguardian.com/environment/2014/feb/13/storms-floods-climate-change-upon-us-lord-stern, Accessed 13.03.14.

Further Reading

Gibbs, D., and O'Neill, K. 2015. Building a Green Economy? Sustainability Transitions in the UK Building Sector. *Geoforum*, 59: 133–141.

Greenwood, D. 2012. The Challenge of Policy Coordination for Sustainable Sociotechnical Transitions: The Case of the Zero-Carbon Homes Agenda in England. *Environment and Planning C* 30: 162–179.

Greenwood, D., Congreve, A., and King, M. 2016. *The Future of Policy and Standards for Low and Zero Carbon Homes*. London: Royal Institute of Chartered Surveyors. www.rics.org.

Mössner, S. 2015. Sustainable Urban Development as Consensual Practice: Post-Politics in Freiberg, Germany. *Regional Studies*, 50(6): 971–982.

References

Aldersgate Group. 2011. *Greening the Economy—A Strategy for Growth, Jobs and Success*. London: Aldersgate Group.

BERR. 2007. *Renewables Advisory Board Annual Report*. London: BERR.

BMU, (Bundesministerium für Umwelt, Naturschutz und Reaktorsicherheit). 2007. *Taking Action Against Global Warming: An Overview of German Climate Policy*. Berlin: BMVBS.

Boschmann, E.E., and J.N. Gabriel. 2013. Urban Sustainability and the LEED Rating System: Case studies on the Role of Regional Characteristics and Adaptive Reuse in Green Building in Denver and Boulder, Colorado. *The Geographical Journal* 179 (3): 221–233.

Brown, H.S., and P.J. Vergragt. 2008. Bounded Socio-Technical Experiments as Agents of Systemic Change: The Case of a Zero-Energy Residential Building. *Technological Forecasting and Social Change* 75: 107–130.

BVBS. 2010. *Building the Future: The Magazine of the Zukunft Bau Research Initiative*. Berlin: Federal Ministry of Transport, Building and Urban Development.

CBI. 2007. *Climate Change: Everyone's Business—A Report from the CBI Climate Change Task Force*. London: CBI.

Cutland, N. 2012. *Learning from Germany's Passivhaus Experience*. Watford: NHBC.

Darby, S. 2006. Social Learning and Public Policy: Lessons from an Energy-Conscious Village. *Energy Policy* 34 (17): 2929–2940.

DCLG. 2006a. *Building A Greener Future: Towards Zero Carbon Development*. London: DCLG.

———. 2006b. *Code for Sustainable Homes: A Step Change in Sustainable Home Building Practice*. London: DCLG.

———. 2008. *The Code for Sustainable Homes: Setting the Standard in Sustainability for New Homes*. London: HMSO.

DECC. 2011. *The Carbon Plan: Delivering Our Low Carbon Future*. London: DECC.
Deutsche Bank. 2010. *Green Buildings—A Niche Becomes Mainstream*. Frankfurt: Deutsche Bank Research.
Disch, R. Undated. *The PlusEnergy House for Every Community*. Freiburg.
Doyle, T. 2005. *Environmental Movements in Minority and Majority Worlds: A Global Perspective*. New Brunswick: Rutgers' University Press.
European Commission. 2011. *A Roadmap for Moving to a Competitive Low Carbon Economy in 2050*, COM 112 final, European Commission: Brussels.
Fastenrath, S., and B. Braun. 2016. Sustainability Transition Pathways in the Building Sector: Energy Efficient Building in Freiburg (Germany) [Online first]. *Applied Geography.* https://doi.org/10.1016/j.apgeog.2016.09.004.
Fischer, J., and S. Guy. 2009. Re-interpreting Regulations: Architects as Intermediaries for Low Carbon Buildings. *Urban Studies* 46 (12): 2577–2594.
Galvin, R. 2010. Thermal Upgrades of Existing Homes in Germany: The Building Code, Subsidies, and Economic Efficiency. *Energy and Buildings* 42 (6): 834–844.
Galvin, R., and M. Sunikka-Blank. 2013. Economic Viability in Thermal Retrofit Policies: Learning from Ten Years of Experience in Germany. *Energy Policy* 54: 343–351.
Geels, F.W. 2002. Technological Transitions as Evolutionary Reconfiguration Processes: A Multi-Level Perspective and a Case Study. *Research Policy* 31 (8–9): 1257–1274.
———. 2005. *Technological Transitions and System Innovations: A Co-evolutionary and Socio Technical Analysis*. Cheltenham: Edward Elgar.
Geels, F.W., and R. Raven. 2006. Non-linearity and Expectations in Niche-Development Trajectories: Ups and Downs in Dutch Biogas Development (1973–2003). *Technology Analysis and Strategic Management* 18 (3–4): 375–392.
Gibbs, D., and K. O'Neill. 2014. Rethinking Socio-Technical Transitions and Green Entrepreneurship: The Potential for Transformative Change in the Green Building Sector. *Environment and Planning A* 46 (5): 1088–1107.
———. 2015. Building a Green Economy? Sustainability Transitions in the UK Building Sector. *Geoforum* 59: 133–141.
Greenwood, D., A. Congreve, and M. King. 2016. *The Future of Policy and Standards for Low and Zero Carbon Homes*. London: Royal Institute of Chartered Surveyors. www.rics.org.
Grin, J., J. Rotmans, and J. Schot. 2010. *Transitions to Sustainable Development New Directions in the Study of Long Term Transformative Change*. London: Routledge.
Hartenberger, U. 2011. Why Buildings Matter: Making Homes and Offices Sustainable Has a Direct Impact on the Way We Live and How We Use Natural Resources. *The Guardian*, July 1.
Hinrichs, C.C. 2014. Transitions to Sustainability: A Change in Thinking About Food Systems Change. *Agriculture and Human Values* 31: 143–155.
HM Treasury and BIS. 2011. *The Plan for Growth*. London: HM Government.

Hodson, M., E. Burrai, and C. Barlow. 2016. Remaking the Material Fabric of the City: 'Alternative' Low Carbon Spaces of Transformation or Continuity? *Environmental Innovation and Societal Transitions* 18: 128–146.

Kemp, R., J. Schot, and R. Hoogma. 1998. Regime Shifts to Sustainability Through Processes of Niche Formation: The Approach of Strategic Niche Management. *Technology Analysis and Strategic Management* 10 (2): 175–196.

Kill, J., S. Ozinga, S. Pavett, and R. Wainwright. 2010. *Trading Carbon: How It Works and Why It Is Controversial*. Brussels: FERN.

Lafferty, W., and E. Hovden. 2010. Environmental Policy Integration: Towards an Analytical Framework. *Environmental Politics* 12 (3): 1–22.

Marres, N. 2013. *Material Participation: Technology, the Environment and Everyday Publics*. Basingstoke: Palgrave.

Mason, K. 2013. Justice in Building, Building in Justice: The Reconstruction of Intra-Generational Equity in Framings of Sustainability in the Eco-Building Movement. *Environmental Values* 32 (1): 99–118.

McLeod, R., C. Hopfe, and Y. Rezgui. 2012. An Investigation into Recent Proposals for a Revised Definition of Zero Carbon Homes in the UK. *Energy Policy* 46: 25–35.

McManus, A., M. Gaterell, and L. Coates. 2010. The Potential of the Code for Sustainable Homes to Deliver Genuine 'Sustainable Energy' in the UK Social Housing Sector. *Energy Policy* 38: 2013–2019.

Mössner, S., and T. Freytag. 2013. *Questioning the Green City Model: A Critical Perspective on Sustainable Urban Development in Freiburg*. Paper presented at Regional Studies Network seminar, Luxembourg.

Mössner, S. 2015. Sustainable Urban Development as Consensual Practice: Post-Politics in Freiberg, Germany. *Regional Studies* 50 (6): 971–982.

Nilsson, M., and A. Persson. 2003. Framework for Analysing Environmental Policy Integration. *Journal of Environmental Policy and Planning* 5 (4): 333–359.

O'Neill, K., and D. Gibbs. 2014. Towards a Sustainable Economy? Socio-Technical Transitions in the Green Building Sector. *Local Environment* 19 (6): 572–590.

Owen, A., G. Mitchell, and A. Gouldson. 2014. Unseen Influence—The Role of Low Carbon Retrofit Advisers and Installers in the Adoption and Use of Domestic Energy Technology. *Energy Policy* 73: 169–179.

Preller, B., J. Affolderbach, C. Schulz, S. Fastenrath, and B. Braun. 2017. Interactive Knowledge Generation in Urban Green Building Transitions. *The Professional Geographer* 69 (2): 214–224.

Raman, S., and E. Shove. 2000. The Business of Building Regulation. In *The Business of Greening*, ed. S. Fineman, 134–150. London: Routledge.

Schot, J., and F.W. Geels. 2008. Strategic Niche Management and Sustainable Innovation Journeys: Theory, Findings, Research Agenda and Policy. *Technology Analysis and Strategic Management* 20 (5): 537–554.

Seyfang, G. 2010. Community Action for Sustainable Housing: Building a Low Carbon Future. *Energy Policy* 38: 7624–7633.

Shove, E. 2003. *Comfort, Cleanliness and Convenience*. Oxford: Berg.

Smith, A. 2003. Transforming Technological Regimes for Sustainable Development: A Role for Alternative Technology Niches? *Science and Public Policy* 30 (2): 127–135.

———. 2006. Governance Lessons from Green Niches: The Case of Eco-Housing. In *Governing Technology for Sustainability*, ed. J. Murphy, 89–109. London: Earthscan.

Smith, A., and A. Stirling. 2007. Moving Outside or Inside? Objectification and Reflexivity in the Governance of Socio-Technical Systems. *Journal of Environmental Policy & Planning* 9 (3–4): 351–373.

Sustainable Development Commission. 2006. *Stock Take: Delivering Improvements in Existing Housing*. London: SDC.

Tofield, B. 2012. *Delivering a Low-Energy Building: Making Quality Commonplace*. Norwich: ADAPT Low Carbon Group.

Tweed, C. 2013. Socio-Technical Issues in Dwelling Retrofit. *Building Research and Information* 41 (5): 551–562.

UNEP. 2016. *Global Roadmap: Towards Low GHG and Resilient Buildings*. Nairobi: UNEP.

Vickers, I., and P. Vaze. 2009. *SMEs in a Low Carbon Economy: Final Report for BERR Enterprise Directorate*. London: Middlesex University. http://www.raeng.org.uk/education/vps/pdf/Engineering_a_low_carbon_built_environment.pdf. Accessed 12 Apr 2012.

Weaver, W. 2006. Brown Pledges to Build Zero Carbon Homes. *The Guardian*, December 6. https://www.theguardian.com/environment/2006/dec/06/politics.greenpolitics. Accessed 14 June 2016.

30

Green Universities: The Example of Western Kentucky University

Leslie A. North and Christian N. Ryan

Background

As threats to biological and ecological systems and services continue to increase globally, environmental education and awareness are rapidly becoming critical components of any efforts to minimize or avoid these threats. An informed populace may be one of the most effective tools for generating beneficial change in how humans interact with the environment (Palmer 1998). To establish support and engagement in sustainable actions, members of society must first understand the necessity of living a sustainable lifestyle and promoting sustainable development. Educational institutions, as places of learning, are, thus, in a unique position to affect change on both local and global scales. As stated best by David Orr in *The Last Refuge: Patriotism, Politics, and the Environment in an Age of Terror*, "No institutions in modern society are better equipped to catalyze the necessary transition to a sustainable world than universities. They have access to the leaders of tomorrow and the leaders of today. They have buying and investment power. They are widely respected. Consequentially what they do matters to the wider public" (Orr 2004).

While some authors have argued that educational institutions have, in part, created an unsustainable society (Phillips 2011), universities have an important role to play in providing the leadership and innovation to help society transition to a sustainable future. The mission of any educational institution

L. A. North (✉) • C. N. Ryan
Western Kentucky University, Bowling Green, KY, USA

R. Brinkmann, S. J. Garren (eds.), *The Palgrave Handbook of Sustainability*,
https://doi.org/10.1007/978-3-319-71389-2_30

is to prepare students to be productive, engaged, and socially responsible leaders in an increasingly global society. Moreover, universities and schools are often influential organizations within the communities they serve. While educational institutions have failed, in some regards, to develop an adequate response to sustainability challenges, the sustainability initiatives pursued at universities can have positive and meaningful economic and social equity and environmental outcomes that extend far beyond a campus property.

University campuses are often self-contained communities within communities. They have near autonomous control over their built environment and access to vast amounts of knowledge and research capability. These institutions can be an invaluable arena in which to experiment with unique approaches to addressing environmental issues since they can be a microcosm of broader communities (Reynolds 2010). This experimentation can be used to educate the students and communities they serve about sustainability practices. In short, "…the campus environment, including buildings, grounds, energy and resource use, waste production, and academic focus, can foster an understanding that humans are embedded in and dependent upon the web of life, and that our personal and collective lifestyle choices have both local and far-reaching impacts on other humans, other organisms, and ecosystems…" (Reynolds 2010).

According to Sterling (2004), universities or any educational institution can contribute to the promotion of sustainability through a combination of three approaches: (1) education about sustainability (content and skills emphasized in curriculum), (2) education for sustainability (the greening of an institution through reform in policy and practice), and (3) education for capacity building (emphasis on action and experimental learning that transcends traditional classroom education). Universities, thus, have an obligation to establish sustainability policies and practices, offer opportunity for learning through hidden curriculum, and give students the applied skill set to tackle real-world sustainability challenges. "Learning institutions are uniquely well placed to…helping learners develop the skills to survive and thrive in the challenging conditions of the twenty-first century, and contribute to a more sustainable future" (Phillips 2011).

Case Study

For the purposes of this text, the authors selected Western Kentucky University (WKU) as a case study site to illustrate how a university can use collaborative, innovative thinking to participate effectively in the sustainability movement.

WKU sustainability efforts encompass reducing our environmental footprint, improving campus health and wellness, and effectively integrating environmental and sustainability themes within educational and research programs. In contrast to many universities that presently promote sustainability through education and operations endeavors, WKU has achieved great success with a very limited university budget commitment and a full-time sustainability staff of one; thus, WKU represents a model for promoting sustainability at university campuses that can be adopted virtually anywhere, given a little creativity and tenacity.

WKU is a comprehensive, four-year university located in Bowling Green, KY. The university is situated in a suburban setting, covering 235 acres. Across six colleges, the University employs more than 1200 full-time faculty and 2200 full-time staff. WKU maintains a student enrollment between 18,000 and 23,000 students each year, with 3000–5000 of these students enrolled in graduate degree programs. The vast majority of students at WKU come to the university from southern states, particularly, Texas, Louisiana, Mississippi, Alabama, North Carolina, South Carolina, Arkansas, Tennessee, West Virginia, Virginia, and, of course, Kentucky. In addition to the domestic student population, the University consistently enrolls between 1100 and 2000 international students who hail from 50 to 70 countries during any given academic year. The largest contingencies of international students at WKU are from China, Saudi Arabia, and India (Western Kentucky University 2016).

As an educational institution first and foremost, WKU strives to create an atmosphere conducive to student engagement and sustainability creativity in a state that has a long history with environmental issues. Whether it concerns coal, natural gas, the damming of rivers, or groundwater contamination, WKU has played a central role in training its faculty, staff, and students to be informed and active citizens in the global effort to become greener and less consumptive of environmental resources. WKU exemplifies the notion that being green is primarily about the passion and vision of its campus community in striving to be innovative and outcome driven. As an institution of higher education, WKU has demonstrated commitment to a moral obligation to its students, the local and global communities, and the planet to do their part in mitigating environmental problems through sustainability initiatives and by training their students to prepare for crucial emerging issues.

Collectively, the sustainability efforts at WKU aim to reduce college tuition and living expenses, increase retention, increase employability, and foster civic and community skills. WKU has led by example in being a model of sustainable practices and cost-effective measures to create a green community from

which students, faculty, and staff can live and learn. Like many universities, WKU has understood the imperatives of creating a sustainable campus where wellness and sustainability education are vigorously pursued and structurally supportive. As a result, although not without challenge, the efforts of the University have clearly multiplied over time. As stated by Dr. Gary Ransdell, former President of WKU

> The broad effort of incorporating sustainable practices and concepts into our campus operations and academics has become an imperative in recent years. As an institution of higher education, we have a mandate to model and teach environmental stewardship and social responsibility. Each member of our campus community (faculty, staff, students and administrators) has a role to play in advancing sustainability at WKU.

As stated by Dr. Henry Hardin Cherry, WKU Founder and First President, "It is the duty of every American to plant more, produce more, save more, and give more." These founding words have echoed in the spirit of the University since its founding in 1906 though sustainability was not formally acknowledged at the University administration level until 2008. In 2008, WKU created the Office of Sustainability, hired a Sustainability Coordinator, and put together a campus-wide 15-member Sustainability Committee that advises the President in response to the growing awareness and need for environmental stewardship at the university level. Since this time, WKU has initiated several major programs to create a campus and community that live sustainably as individuals and as a whole. In fact, in 2016, the University was selected as one of the first universities to become a United States Department of Education Green Ribbon Schools award winner.

In alignment with Sterling's (2004) three categorical levels for contributing to sustainability at Universities, WKU has consistently attempted to reduce their environmental impact, improve wellness on campus, and provide first-rate environmental and sustainability education for Kentuckians and for international and distance-learning students. The primary strength of WKU lies in the University's educational instruction. The University is home to the consistently top-five ranked high school in America, the Carol Martin Gatton Academy for Mathematics and Science. Through this Academy, Kentucky high school students live and learn in a college setting while earning their high school diploma and focusing on research and engagement in STEM disciplines. Additionally, WKU is home to the only independent honors college in the state, which provides an opportunity for high-achieving students to excel in their respective fields by taking more challenging courses and completing a

thesis project. STEM initiatives at WKU range from living laboratories to study abroad opportunities that provide international experiences in sustainable service learning and interdisciplinary environmental research for students. Undergraduate and graduate degrees and certificates at WKU address the science, social, economic, and political aspects of environmental change and sustainability, providing both disciplinary depth and interdisciplinary perspective-taking that pave the way for students to get jobs and to make positive change in their communities.

There are thousands of sustainability-related activities taking place at universities across the globe. Sustainability practices can be used at universities to reduce waste, improve operational efficiency across a campus, and reduce budgetary burdens, among many other benefits. In the following text, a categorical selection of sustainability initiatives undertaken at WKU is highlighted to demonstrate sustainability initiatives that result in significant outcomes with relatively little investment other than collaboration and creativity.

Energy Conservation

Since 2009, with the adoption of a comprehensive and aggressive University Energy Policy, WKU has reduced energy use by 28 percent (kWh per square foot) through conservation and efficiency projects in all areas of facilities management and campus services. Among these policies and programs, energy conservation and efficiency have been the main focus. In fact, WKU is a leader in Kentucky, as well as nationally, in pioneering initiatives that address environmental issues at the local, state, national, and international levels. For example, WKU's Energy Policy was adapted and adopted by the City of Bowling Green, Kentucky. The WKU "Conservation Vacation" is an initiative introduced in 2009 to save energy over the winter break.

Through the Conservation Vacation program, the WKU main campus engages in a general shutdown of all unessential or unnecessary energy draws. The Department of Facilities Management turns back temperatures, turns off all but egress lighting, and unplugs vending machines. The Restaurant and Catering staff combine all cold food storage to fewer freezers, taking the opportunity to turn off and defrost and clean those left empty. The Parking and Transportation Department closes empty parking lots and turns off unnecessary parking lot lighting. All faculty and staff are asked to unplug copy machines, coffee makers, and other office equipment and appliances that are not essential to remain plugged in. For the program to be successful,

communication is key; faculty work with the Facilities staff to provide special needs information such as research labs that house animals or temperature sensitive research material. Additionally, faculty and staff that will be using campus space over the break may request conditioning as needed. Finally, those that are on campus during the break are encouraged to report unnecessary energy draws that may be addressed for further conservation.

This exercise not only communicates the importance of responsible energy use as a university commitment but also has helped facilities staff identify endless opportunities for efficiency and conservation in campus infrastructure. For example, it was not until the first Conservation Vacation that it was realized that in many areas of buildings built in the 1960s, light switches were inaccessible to most building occupants. As a consequence, lights had been on in those areas 24 hours per day, every day since the building was first occupied. The WKU Conservation Vacation has resulted in overall savings of more than three million kilowatt hours of energy, which equates to cost savings of approximately $264,000 and mitigation of 2191 metric tons of greenhouse gas emissions (Fig. 30.1).

Energy conservation efforts are not limited to operations at WKU; the entire campus community is engaged in energy education and awareness activities. WKU has a web-based, WKU real-time energy use feedback

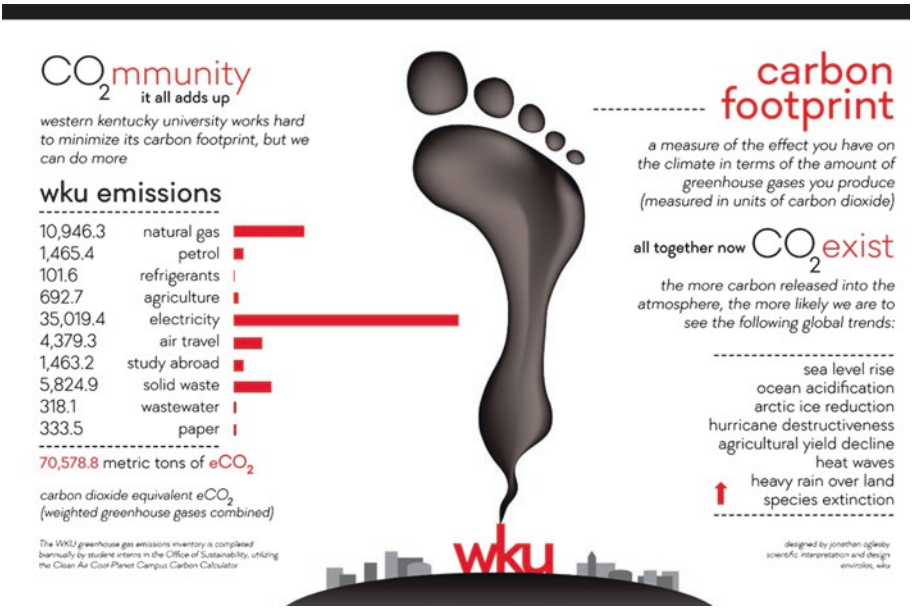


Fig. 30.1 WKU carbon footprint infographic

program, allowing public viewing of energy use for nearly all campus buildings. This program expresses energy used in meaningful units, including associated CO_2 emissions and dollars. Such a program can be used as a tool to engage students in nationwide competitions. The WKU Office of Sustainability conducted university greenhouse gas emissions inventories in 2009 and 2012. These inventories serve to guide the institution in greenhouse gas reduction strategies, such as the conversion of the Central Steam Plant from coal to natural gas in 2011. The upgrade allows for heating of the main campus more efficiently, with lower environmental impact. The upgrade was financed completely with utility savings resultant from efficiency and conservation projects.

As per the University's comprehensive Energy Policy adopted in 2009, WKU is committed to build and renovate to LEED standards in all building projects. WKU is proud to have no fewer than nine LEED Accredited Professionals on staff. Some of the unique LEED building practices include tile floors made from recycled glass, furniture made of recycled plastic bottles, reflective roofing materials, and informational videos as digital art pieces used to educate building visitors of the green features present in some buildings. These videos were created as course projects, engaging students in the effort to educate others on the features of LEED Certified buildings.

The WKU Office of Sustainability, housed in an on-campus residence that was built in 1931, serves as a best practice sustainability demonstration home, providing students and community residents with well-researched, practical solutions to improving the performance of the average household. Students from a diversity of disciplines, including engineering, agriculture, environmental science, geography, and ecology, are engaged in monitoring before and after performance of the house and landscape. In October 2014, a photovoltaic array was installed on the house, and in 2015, with the installation of insulation, high-efficiency windows, and the use of high-efficiency electronics and appliances, the house became the first net zero electricity office on campus. Local business owners, recognizing the opportunity to educate students who will eventually be homeowners themselves, provided most of the materials and equipment for the house.

A Campus Community

The WKU campus is known for its remarkable landscape that features a diverse campus forest, gardens that provide wildlife habitat, and use of native and drought-tolerant species. WKU strives to utilize sustainable, best practices,

such as water and energy conservation, storm water management, and lower combustion engines, while maintaining the highest level of aesthetic and appeal possible. Campus services have replaced all gas-burning riding mowers with lower emission, bio-ready diesel mowers. Drought-resistant, native plant xeriscapes, rain gardens, and habitat gardens are being incorporated into the landscape. Native plants attract a more diverse array of native animal species, further increasing biodiversity within the campus landscape. We are harvesting rainwater and using organic pesticides, such as neem oil, in our greenhouses. Many campus gardens are mulched with gravel, which does not break down and increases water infiltration to the soil. Since 2010, rainwater collection systems, used for irrigation, have been installed at five locations and collect as much as 45,000 gallons of water for watering campus trees and gardens. In 2010, WKU became a Tree Campus USA, a designation awarded by the Arbor Day Foundation. Each year, this designation is renewed, demonstrating a commitment to care for the campus' forest of more than 3450 trees of more than 100 different species. WKU former President, Dr. Gary Ransdell, served on the university tree care committee and personally approved every tree removal request. "Ransdell's Rule" states that for each tree removed, two will be planted. In 2015, the WKU main campus became a certified arboretum and was also recognized by the National Wildlife Federation in their first publication of *The Campus Wild: How College and University Green Landscapes Provide Havens for Wildlife and "Lands-on" Experiences for Students*.

In broader efforts to improve quality of life in the region and across the WKU campus community, WKU supports the local food system in partnership with the Community Farmers Market (CFM). Through US Department of Agriculture grant funds, WKU and CFM are addressing the needs of underserved populations, improving access and affordability of fresh, local foods. A "mobile market" has been purchased and is used to deliver fresh, local, healthy foods to underserved populations (the mobile market also visits campus regularly). WKU has provided CFM space to operate year-round, supporting full-time farmers in their provision of local foods to the community. WKU has also partnered with the Community Farmers Market to accept Big Red Dollars (on-campus student spending account funds). Through the *Double Dollar* program, it matches each Big Red Dollar (up to US$10) through private donations, incentivizing students to affordably purchase fresh, local, and healthy food.

WKU seeks to increase local food purchasing for campus dining outlets by working with local farmers to help them become approved vendors for our campus catering and dining services partner, Aramark. As a Kentucky Proud campus, WKU features Kentucky Proud products in dining outlets,

convenience stores, and athletics venues. Campus coffee shops utilize Udderly Kentucky milk, and since WKU is a Fair Trade University, Fair Trade coffee and tea options are available every day.

The yard at the Office of Sustainability serves as an educational landscape, designed and maintained by Student Fellows, and the entire yard is edible, comprising the *Project Grow* campus community garden. The garden serves as a space for diverse students and organizations to come together, with an "Adopt a Plot" program and community workdays for aspiring green thumbs. The garden also supports a campus food assistance program. The WKU Office of Sustainability is home to the WKU Food Pantry, offering assistance to students, faculty, and staff experiencing food insecurity. The Food Pantry is supported by both campus and community organizations, such as Greek organizations who organize regular food collection drives. A designated Food Pantry garden plot allows for inclusion of fresh vegetables in the Food Pantry, and demonstrated cooking classes are offered regularly at the Office of Sustainability as well. Finally, the Office of Sustainability is home to *Big Red Bikes*, a free bike-lending library, comprising refurbished bikes abandoned on campus and donated by supporters. The bikes are refurbished and maintained by a student bike mechanic, a student employment position supported financially by the Department of Parking and Transportation services. The bike shop is equipped with tools and supplies purchased with funds provided by a Kentucky Department of Transportation grant written by the student mechanic.

Effective Education

WKU strives to communicate the myriad green practices to its students and the community and incorporate an environmental and sustainability theme in a growing number of courses, student activities, and educational initiatives. WKU has over a dozen academic degrees focused on the environment or sustainability ranging from certificates to graduate degrees. These programs are rooted in the physical sciences, business, public health, social sciences, and interdisciplinary studies, thereby providing depth and interdisciplinary structure to their offerings. At the graduate level, WKU is home to the only master's program in the United States, an MA in Social Responsibility and Sustainable Communities, that addresses the interrelated themes of social justice, community studies, and environmental sustainability. As an online program, the MA is an attractive option for Kentuckians and others, nationally and internationally, and helps prepare students for the challenging task of leading communities to social and environmental health.

Students are intentionally involved in *all* of the education- and research-based sustainability programs implemented at WKU, actively researching the successes, challenges, and future goals of the University's initiatives to ensure WKU is meeting, and even learning how to surpass, its goals and expectations. This effort results in benefits to students and the university and helps reduce the financial burden of the sustainability program on the University.

Students have been engaged in advancing sustainability at WKU through Honors Capstone Projects and graduate research through such initiatives as the design of an edible landscape at the Office of Sustainability; conducting the main campus greenhouse gas emissions inventories; collection and interpretation of data for the bi-annual Association for the Advancement of Sustainability in Higher Education Sustainability Tracking, Assessment, and Rating System; assessing the potential for rainwater collection on campus; achieving Fair Trade University status for WKU; implementation of a reusable to-go container program in the campus dining hall; peer-to-peer energy conservation awareness programs such as residence hall competitions; and a variety of other programs and initiatives.

WKU offers a campus Green Tour with accompanying online guide and 11 interpretive signs placed throughout campus that describes the green initiatives undertaken at the University. Students in different classes were involved in the development of the signs. The intent of the signs is to communicate environmental initiatives to the campus and broader communities. This tour is frequently used as a recruiting tool for the University.

An example of an innovative course offered at WKU is the co-taught *Environment and Journalism*, which puts geoscience and journalism students into teams to learn strategies to effectively communicate environmental science topics through media, particularly the Bluegrass Pipeline and coal in Kentucky. Another is the *Global Environmental Change* course taught in conjunction with Bowling Green High School wherein undergraduates from WKU joined high school seniors to learn about environmental service learning. This program included the creation of sustainable initiatives, such as a recycling program, greenhouse restoration, and raising bees for local honey.

Lessons Learned

Lessons learned from WKU sustainability activities:

– Setting a realistic reduction goal for energy and resource use is key. A realistic goal gives everyone something to shoot for and makes for good story when you are able to celebrate meeting your goal.

- Communication of support from a University President and Provost crucial. A simple email encouraging support of any sustainability initiative from leadership is extremely helpful for establishing a sense of community around a University's sustainability programs.
- There are many special circumstances, such as research laboratories, that must be handled individually when it comes to various sustainability initiatives to avoid damage or disruption to research projects. Importance of compromise and willingness to make reasonable exceptions cannot be emphasized enough based on experiences at WKU.
- Be prepared to learn about inefficiencies you never even realized existed and infrastructure barriers such as lighting installed without switches.
- Use feedback mechanisms to consistently keep the community engaged. If you don't have a website or other means by which to show progress toward sustainability goals, a well-timed email halfway during the break with an update on where you stand in relation to identified goals is well-received and keeps the campus community motivated.
- Communication, communication, communication! Faculty and staff resistance to sustainability-driven changes across a campus occurs mostly due to misinformation. This holds true for any sustainability initiative that an educational institution may be attempting to pursue.
- With regard to a *Conservation Vacation*, provide an email or telephone number for members of the campus community to contact if they are on campus during the break and observe something that was missed. For example, you may receive reports such as "building X has all of the third floor lights on." At WKU opening, this form of communication produced great feedback and encouraged participation and engagement.
- Create a mechanism by which members of the campus community interested in sustainability can communicate with one another and/or have a central site where they can share information. For example, perhaps there are two professors on a campus eager to create and offer an innovative, interdisciplinary course, yet they are unaware of the interests of their colleagues.
- Buy-in from various departments across the campus is crucial. In some instances, departments may develop individual execution plans for the implementation of sustainability programs. Examples from WKU's *Conservation Vacation* include:
  - College of Science and Technology developed and communicated interdepartmental procedures and guidelines for shutdown.
  - Parking and Transportation developed plan for parking lot closures and turned off parking lot lights to safety levels.

- Restaurant and Catering consolidated perishables to one freezer and unplugged all others.
- Auxiliary Services obtained agreement from vending provider to unplug vending machines.

Challenges and Barriers

Top-Down Directives and Lacking Buy-In from the Campus Community

Nature teaches us that resiliency is a result of diversity; the same rule can be applied in organizational sustainability. Initiatives that are issued as top-down directives lack buy-in from the organizational community and often do not last. When WKU decided that it was imperative to create an energy policy that would help the University use energy responsibly, a committee of students, faculty, and staff was created to write the policy. This policy was vetted through various university departments including parking and transportation, purchasing, information and academic technology, and planning, design, and construction. The involvement of all of these stakeholders resulted in a policy that was essentially created by the campus community and therefore had widespread support before it ever became official. This experience set the stage for the continued engagement of all stakeholders in subsequent sustainability initiatives. Furthermore, it places university administrators in a position to say "yes," as it is easy to approve and support an idea that was collaboratively created by all relevant stakeholders. Initiatives that are created through inclusivity are more enduring, sustained by a diversity of empowered individuals rather than an individual of authority.

Those Resistant to Sustainability

Change agents are often compelled to focus on those departments or individuals who are the most resistant to sustainability initiatives—clearly they need it the most! However, the limited resources of energy and time are better spent on those that want to do better and are open to making sustainable change. Working with those that are enthusiastic about adopting sustainable practices results in more immediate successes, a better return on time and energy. The celebration of sustainable change often compels those who were initially less enthusiastic to join the effort and share in the success.

Pragmatism Versus Idealism

Best practices are best shared, but one size does not fit all. The initiatives that have been the most successful at WKU are those that fit well with that place. A sense of place considers practicality and culture. In Kentucky, where energy is relatively inexpensive, vast opportunity lies in conservation and efficiency programs, so initially these areas were a far more practical investment than renewable energy projects. Located in the midst of an agricultural region, local sourcing of food products (particularly those with the Kentucky Proud logo) is an initiative that resonates with the campus and greater community and fits very well with the WKU sense of place and the story of its residents.

Keeping the Campus Community Committed and Involved

Sustainability initiatives at a University will only be successful if the campus community is consistently committed to supporting the programs. At WKU, each year, a faculty member and a student are recognized with the President's Award for Sustainability. These individuals demonstrate leadership in education and/or activities that promote sustainability at WKU and instill a culture of stewardship, conservation, and social responsibility. Additionally, although they may be time-consuming to pursue, third-party recognitions and certifications and honors such as the Green Ribbon School award from the US Department of Education, Tree Campus USA, and World Wildlife Federation Campus Ecology Program *Campus Wild* designation are points of pride that can be included in recruiting materials and provide opportunity to spread awareness about sustainability efforts and initiatives through campus celebrations and publicity.

Student Involvement

Student involvement in driving and supporting sustainability programs is a critical component of any green university activity. Although uncompromisingly necessary, this involvement does not go without a challenge. The demands on students can be enormous and can fluctuate from semester to semester. As these demands change, the attention students give toward sustainable initiatives also waxes and wanes. Similarly, students graduate, presenting challenges for the institutional memory of programs. Keeping detailed records of any activities pursued at the University and ensuring multiple stu-

dents are involved in each project—so any time burdens can be collectively shared among members of the entire group—can significantly help address these student involvement-based challenges.

Lack of Funding and Human Power

With any university program, sustainability related or, otherwise, a lack of funding and of human power can be challenging to overcome. Thinking outside the box is the best strategy for overcoming such resource challenges. Use savings from programs to reinvest into sustainability, thus creating a snowballing fund of resources that can be used to support future programs. Allowing students to use the programs to apply skills learned in the classroom serves as a win-win for both the students and campus-wide greening.

Conclusions

Being a green campus is not about size or available funding. At WKU, it is about creating a community of practice and scholars dedicated to the pursuit of a sustainable future, both locally and globally, which spans disciplines and encourages engagement from every member. The University has attempted to increase research engagement with students to address some of the world's most critical environmental problems using a range of discipline-focused and interdisciplinary approaches while continuing to make progressive changes on our campus to reduce energy costs and our carbon footprint. WKU's success in shifting the campus culture to one that is committed to sustainability is the result of the employment of a few simple strategies. First, efforts are emergent, intentionally inclusive of a diversity of stakeholders. Second, in building this emergent structure of sustainability supporters, the focus at WKU is on working with those most eager to get involved. Third, each sustainability initiative is chosen on the basis of pragmatism and sense of place. Finally, WKU tries to take full advantage of the power of third-party recognitions and certifications.

Future Reading

Aber, J., T. Kelly, and B. Mallory. 2009. *The Sustainable Learning Community: One University's Journey to the Future*. Lebanon: University of New Hampshire Press.

Association for the Advancement of Sustainability in Higher Education. Available at: www.aashe.org.
Bartlett, P.F., and G.W. Chase. 2004. *Sustainability on Campus: Stories and Strategies for Change*. Cambridge, MA: MIT Press.
Egan, T. 2006. The Greening of America's Campuses. *The New York Times*, [online] January 8. Available at: http://www.nytimes.com/2006/01/08/education/edlife/the-greening-of-americas-campuses.html.
Farrell, J.J. 2010. *The Nature of College: How a New Understanding of Campus Life Can Change the World*. Minneapolis: Milkweed Editions.
Filho, W.L. 2000. *Sustainability and University Life*. 2nd ed. New York: Peter Lang Publishing, Inc.
———. 2009. *Sustainability at Universities—Opportunities, Challenges and Trends*. New York: Peter Lang Publishing, Inc.
National Wildlife Federation's Campus Ecology Greener Campus Webinar Series. Archives of Past Webinars available at: http://www.nwf.org/Campus-Ecology/Events/Greener-Campus-Webinars.aspx.
Simson, W. 2008. *The Green Campus: Meeting the Challenge of Environmental Sustainability*. Alexandria: APPA Association of Higher Education.
Uhl, C.F., and A. Anderson. 2001. Green Density: Universities Leading the Way to a Sustainable Future. *Bioscience 51* (1): 36–42.

References

Orr, D. 2004. *The Last Refuge: Patriotism, Politics, and the Environment in an Age of Terror*. Washington, DC: Island Press.
Palmer, J. 1998. *Environmental Education in the 21st Century: Theory, Practice, Progress, and Promise*. Abingdon: Routledge.
Phillips, A. 2011. Institutional Transformation. In *The Handbook of Sustainability Literacy: Skills for a Changing World*, ed. A. Stibbe. Cornwall: Green Books Ltd. Part 2.
Reynolds, H.L., ed. *2010. Teaching Environmental Literacy: Across Campus and Across the Curriculum*. Vol. 38. Bloomington: Indiana University Press.
Sterling, S. 2004. Higher Education, Sustainability, and the Role of Systemic Learning. In *Higher Education and the Challenge of Sustainability: Contestation, Critique, Practice, and Promise*, ed. P. Corcoran and A. Wals. Dordrecht: Kluwer Academic.
Western Kentucky University. 2016. *Western Kentucky University Fact Book*. Bowling Green. https://wku.edu/instres/documents/2016_fact_book.pdf. Accessed 1 Sep 2016.

31

Events, Festivals, and Sustainability: The Woodford Folk Festival, Australia

Kirsten Holmes and Judith Mair

Background

This chapter considers the issues pertaining to sustainability in relation to festivals and events. It introduces the context of festivals and events, highlighting the growth in the size and scale of the events sector. The chapter then moves on to discuss some of the key sustainability issues and challenges facing events and festivals by examining a case study of a particular event—the Woodford Folk Festival in Australia—which has addressed these challenges in innovative ways. Woodford Folk Festival can be considered as a leading example of best practice in terms of sustainable festivals. Finally, the chapter considers the lessons learned by Woodford Folk Festival in the course of meeting the sustainability challenges and also identifies important lessons for other festival and event organisers.

Special events and festivals are an integral part of people's lives. They bring individuals, families and communities together; they mark important public and private occasions; and provide entertainment. Increasingly they are being used by governments to create jobs, attract investment, generate publicity for, and stimulate tourism in destinations (Allen et al. 2011). There are an enormous variety of planned events including religious celebrations, family

K. Holmes (✉)
School of Marketing, Curtin University, Bentley, WA, Australia

J. Mair
Business School, University of Queensland, St. Lucia, QLD, Australia

R. Brinkmann, S. J. Garren (eds.), *The Palgrave Handbook of Sustainability*,
https://doi.org/10.1007/978-3-319-71389-2_31

milestones, historical commemorations, conferences, business meetings, and arts festivals (Getz 2013). Events can range in size from global occasions such as the Olympic Games to small, community festivals. What these phenomena all have in common is that they are planned—that is, they are organised by an individual or group—and that they are time limited. Events, by definition, have a beginning and an end and occur at a given place and time. They are temporal and noteworthy phenomena often with a special set of circumstances (Getz 2013). Events and festivals each have a deadline and when it passes, the event is over and this presents specific challenges to achieving sustainability.

As the number of events and festivals organised globally has grown, so has concern for the sustainability of these events. This has been particularly highlighted by the costs associated with hosting a mega event such as the Olympic Games or FIFA World Cup, where an enormous investment, including the building of new venues and new infrastructure in the host city has attracted substantial criticism about the long-term use of such facilities. In response to these concerns, the International Olympic Committee (IOC) introduced sustainability concerns into the bid process for prospective host cities with new rules in the Olympic Charter 2003 and IOC Manual for candidate cities from 2001 (IOC 2012). The London 2012 Olympics were the first Olympic Games to be staged according to the new criteria (Sadd and Jones 2009). The London Games was the first to measure its entire carbon footprint and to commit and achieve zero waste to landfill. Additional steps taken at the London Games included redeveloping a brownfield site as the Olympic Park in a deprived area of London, building new public transport lines, and building reusable venues—using sustainably sourced materials—that could be dismantled after the event to be reused elsewhere and to leave more sensibly sized venues in situ for local use (Holmes et al. 2015; Pitts and Liao 2009).

In the context of mega events, which cost millions of dollars to stage and rotate their location each cycle, sustainability is not simply about the event itself but the event legacy—what will be left behind in the destination after the event leaves town? Legacy is a contested concept academically (Preuss 2007) but is generally considered to include the physical legacy, the venues, infrastructure, and economic benefits (such as jobs and increased income from tourism), and the soft legacy, increased volunteering, positive feeling among the resident population, and improved health through increased sports participation. While the London Olympic Games have been lauded for their sustainable practice leading up to and included the Games (Pitts and Liao 2009), the legacy has been disappointing. Achieving a positive legacy is challenging (Holmes et al. 2015). Legacy plans are often vague statements

rather than detailed plans designed to promote political support for the event. Funding is rarely ring-fenced for the legacy stage as there is so much pressure to deliver the event on time and to a high standard, often in the glare of the international media. In the case of mega events, there is such a long lead in time from the bidding phase to the post-event legacy stage that legacy planning is a challenge. The Global Financial Crisis took place between the announcement of London's successful bid and the staging of the 2012 Olympics, and this had a significant impact on the budget (Holmes et al. 2015).

Getz queries: whose responsibility is the sustainability of any event (Getz 2013)? Should sustainability initiatives be developed at the destination level? The community where the event will take place? Is it the responsibility of the venue or the event organisers? The IOC places the responsibility on the bid team, which is represented by national and local government in the host destination but it is unclear how this is followed up in terms of the post-event legacy, where a different government is often in power. However, many individual events, venues, and sectors of the events industry have also taken steps towards more sustainable events.

Purpose-built event venues have taken the lead, adopting the latest green technology to limit their carbon footprint. Wembley Stadium's waste and water management, alongside excellent public transport connections, assisted Live Earth in meeting their green event targets (Harvey 2009). The Melbourne Convention Centre was the first venue to be awarded the six-star environmental rating by the Green Building Council of Australia (http://mcec.com.au/plan-an-event/why-choose-mcec/) both in its construction and operation including composting, catering, and energy use. The Moscone Centre in San Francisco also sets an industry standard through waste management, energy use, water monitoring, and recycling (Holmes et al. 2015).

Greenfield festivals, where the event is held in a temporary venue, often an actual field, were some of the earliest events to show a concern for the event's impact on the environment. A number of factors may have stimulated this trend. Greenfield events, such as Glastonbury music festival in the UK and Coachella in California, frequently have music or alternative themes, which lend themselves to adopting an environmental focus. Often their audiences have a stronger interest in environmental issues. Research by Mair and Laing (2012) suggests that music festival directors often have a desire to educate and advocate for more environmentally responsible behaviour, both from suppliers and attendees. As all resources have to be brought in to the site for the event, there is a clear benefit in reducing. The impact of events on greenfield sites is very visible, with enormous amounts of waste (including food and

drink containers, programmes, and camping equipment left by the audience) needing to be removed at the end of each event.

In recent years, numerous guides, standards, and certification programmes have been developed to encourage event managers to adopt more sustainable practices. The leading programme is ISO 20121, a set of international standards which were first applied in the London 2012 Olympics (Holmes et al. 2015). These grew out of BS8901, British standards developed by the event industry in the UK. Various government bodies, including the UK Government's Department for Food and Rural Affairs and the Tasmanian Environmental Protection Agency have also established guidelines. With specific relevance to greenfield festivals, there are A Greener Festival's guidelines and awards and the Yourope Clean n' Green Awards (Holmes et al. 2015). The trend towards more sustainable events is therefore the result of both initiatives from within the industry and pressure from governments and funding bodies without.

In order to be sustainable, events need to meet the triple bottom line and be environmentally, economically, and socially sustainable as initially set out in the so-called Brundtland report (World Commission on Environment and Development 1987). The experience of past events shows that economic viability is as important as the other elements and one bad year financially can end the run of an otherwise successful event. This was the case of Peats Ridge Festival, which was an exemplar in greenfield event sustainable practice (Holmes et al. 2015). Environmental sustainability in terms of events usually refers to minimising the impact of the event on the local fauna and flora, reducing waste, water, and power use. However, events can actually improve the local environment. Olympic Parks, for example, are often situated on disused brownfield sites with the preparation for the event including regeneration of the site (Pitts and Liao 2009). Social sustainability in the event context focuses on the relationship with local residents around the event site. Recurring events benefit enormously from developing a positive relationship with the local community, who offer a source of both volunteers and audience members. Social issues such as social inclusion, social justice, and tolerance of diversity can all be addressed through events (Mair and Laing 2015).

For most events, the biggest single source of carbon emissions is from audience travel (Jones 2014) and this highlights the particular challenges for event managers. The event management team rely on a wide range of stakeholders to deliver the event (Tiew et al. 2015) and without commitment from these external groups, the impact of following sustainable guidelines will be limited. Events need to achieve buy in from not only audiences but also performers, contractors, vendors, and volunteers. Event managers can use contractual

agreements to obtain compliance from contractors and vendors. They can seek to influence their audience through educational initiatives both before and at the event (e.g. providing clear recycling facilities and refillable water bottles) and offer incentives such as reduced-price tickets for audience member travelling by public transport. However, the time limited nature of events and festivals mean that sustainability principles can be overlooked in order to deliver the event on schedule.

The following case study is an example of a greenfield festival that has grown to be a market leader both in terms of the quality of its product and the way in which sustainability is embedded at all levels of the event organisation.

Case Study Background: Woodford Folk Festival

The case study for this chapter is the Woodford Folk Festival, which takes place each year on the Sunshine Coast, near Brisbane in Queensland, Australia. The festival is a regional music, arts, and performance event lasting six days and nights, from 27 December to 1 January each year. The festival has grown significantly year on year since it began over 30 years ago and now welcomes over 2000 performers and 438 events (Woodford Folk Festival About The Festival 2016). In 2015–16, the festival attracted just under 127,000 visitors, and brought in box-office takings of AU$6.15 million (Sunshine Coast Daily 2016). In 2014, Woodford Folk Festival attendees collectively spent 209,616 visitor nights in Queensland contributing an estimated AU$21 million to the Queensland economy (noise11.com 2016). The majority of these visitors travelled specifically to attend the festival, with 85 per cent of their time spent at the festival. Domestic Australian visitors averaged expenditure of AU$461 per person and international visitors AU$910 per person (noise11.com 2016). The festival's businesses and income streams include 16 bars, 180 stallholders, artists and performers' merchandise, two general stores, and a dispatch department (Rawlings 2016).

The festival takes place on a 500-acre parkland site near the town of Woodford and is managed by the Queensland Folk Federation (QFF—a not-for-profit association and registered charity) in consultation with the traditional indigenous custodians of the land, the Jinibara people. The site has been named Woodfordia. It is located approximately one-hour's drive north of Brisbane, state capital of Queensland, which has a population of just over two million (Australian Population 2016). As a mostly residential event,

Woodfordia has extensive camp grounds to cater for what becomes the 67th largest town in Australia during the week of the festival (Symons 2017).

According to the festival website, the festival features "concerts, dances, street theatre, writers' panels, film festival, comedy sessions, acoustic jams, social dialogue and debate, folk medicine, a children's festival, an environmental program featuring talks, debates and films, arts and craft workshops, circus performances, late night cabarets, parades and special events including a spectacular fire event" (www.woodfordfolkfestival.com). Cleary, the festival embraces a diverse range of programming and appeals to a wide range of audience members, with a significant variety of interests.

In order to give the reader a feel for the size and scale of this festival, the following interesting statistics are provided (Getz 2013):

(1) The festival covers more than 13,000 sq m with tents and built structures.
(2) There are 218 named streets on the festival site.
(3) Volunteer hours are in excess of 1,400,000 hours.
(4) Seventy per cent of festival visitors each year are repeat attendees, and because of the longevity of the festival, there are now second- and even third-generation attendees.
(5) The festival generates an estimated economic impact of AU$15 million per annum.

The mission statement of the QFF is to stimulate, facilitate, and foster the preservation and promotion of folk culture for the common good (Woodford Folk Festival 2016). The festival has a strong sustainability theme running through the organisation, the planning, the management, and the staging of the festival and arguably goes well beyond most other festivals in this respect and thus makes for a very interesting case study of festival sustainability. It is the stated aim of the QFF that Woodfordia should become a cultural parkland dedicated to the arts, humanities, and folklore (The Planting Festival 2016).

Woodfordia: Environment and People

When the Folk Festival began in the 1980s, it took place in the showgrounds of a nearby town (Maleny). However, the success of the festival meant that it quickly outgrew this venue, and a new venue was sought. It was decided that the festival should have a home of its own, and after a search, the site where

the festival now takes place was secured. The land was named Woodfordia. Since the initial 240-acre site was purchased, the QFF has since secured more land adjoining the initial property, making up the current 500-acre site.

The QFF have invested in a large number of infrastructure improvements to the Woodfordia site since it was purchased. Such a project includes the building of amenity blocks, an onsite water treatment plant, an onsite water filtration plant, 55 km of all-weather roads, a 25,000-capacity amphitheatre, and major electrical infrastructure including transformers and power lines. Such developments naturally come at a significant cost, and it is estimated that QFF has invested over AU$14 million in this site (Woodford Folk Festival Our Land 2016). However, many of these infrastructural improvements (such as the onsite water treatment and filtration plants) have a substantial pro-environmental component and additionally have long-term cost benefits.

Whilst the key aims of the QFF are in relation to folk music performance, participation, and sharing, the Woodford Folk Festival has always had a very strong pro-environmental theme. Indeed, their website has an Environmental Statement which states:

> *We recognise that sustainable resolutions to environmental issues can be brought about through a cultural agenda. This provides us not only with opportunities to engage and advocate in this area, but a responsibility to do so.* (Woodford Folk Festival Environmental Statement 2016)

This highlights not only the importance of environmental issues and management to the festival director and organisers but also points to the ability of festivals as cultural activities to lead the way in advocating for change. The QFF and the Woodford Folk Festival take their role as land managers very seriously and the five objectives of the Woodford Environmental Statement underline this:

(1) Enhance the environment
(2) Minimise impacts and provide net gains where possible
(3) Provide educative opportunities
(4) Lead by example
(5) Market leadership

However, Woodford Folk Festival does not simply list empty promises on their website. Instead, there is a substantial amount of information in relation to actions that are taken regularly and consistently by the organisers and the QFF to achieve these objectives.

When the festival site was originally purchased, the land had been cleared for agricultural use and as a result was in a degraded condition. The Woodfordia site is continually being replanted, both by the QFF and also during an annual tree planting festival known as The Planting Festival (http://theplantingfestival.com/). Particular indigenous and rare plant and tree species are carefully selected to create wildlife corridors, improve soil quality, prevent erosion, and create shade for both animals and visitors. Over 100,000 new trees have been put into the ground since the Planting Festival began (The Planting Festival 2016). The QFF also manage the land in consultation with the wishes of the traditional indigenous custodians of the land, the Jinibara people. A range of land and wildlife management practices are employed, including erosion minimisation strategies, careful weed eradication, exclusion of feral animal species, and maintenance of the site as a wildlife haven. The Woodford festival site handles two months of intense human activity each year, but is able to remain a healthy, natural habitat for the rest of the year (Race 2015). It's worth pointing out that this is a reconstructed habitat that may never have been regenerated otherwise.

In relation to potentially negative environmental impacts, the Woodford Folk Festival and the QFF take considerable effort to address these (Woodford Folk Festival Environmental Statement 2016). For example, the festival captures all recyclable waste materials on site, but also strongly encourages all contractors to use recyclable or biodegradable materials on site. Additionally, the festival uses shower wastewater to irrigate the land and minimises use of herbicides to maintain a natural environment. Whilst the festival takes place in a greenfield site, and therefore transport to the festival is required, the festival seeks to minimise carbon emissions associated with transport by actively encouraging the use of public transport and ride-sharing schemes.

An important part of the Woodford ethic is to educate and inspire attendees. All QFF events, including the Woodford Folk Festival, have environmental presentations, workshops, and seminars, and the festival website also includes a list of resources for people seeking further environmental information. In addition to the education opportunities offered, the festival also encourages action by attendees, in terms of tree planting and other environmental projects.

Finally, the Woodford Folk Festival aims to be a leader, both in terms of leading by example and in relation to being the market-leading environmental festival (Woodford Folk Festival Environmental Statement 2016). This includes participating in public forums to influence individuals and community groups in favour of pro-environmental initiatives, using their position as a leading festival to bring together the folk movement, the environmental

lobby, and government agencies and creating a strong image of the festival as being environmentally friendly and responsible, partly through forging strategic alliances only with companies having a strong commitment to the environment.

Woodford Folk Festival also takes its responsibility to the local community seriously. In total, full-time staff number only 25, and over 2300 volunteers are needed to help to run the festival. Many of these, although by no means all, are from the Sunshine Coast region. As Festival Director, Bill Hauritz, notes: "we [the festival] don't ask for money from the Woodford community. We in fact use Woodford community groups (such as Lions Club) and employ them so that there might be benefit for the Woodford community" (Suncoast Times 2015).

The volunteer programme is vast, with 140 different departments. There are over 2000 volunteers involved each year (Woodford Folk Festival "about the festival" website). Woodford describes itself as a volunteer-driven festival and the numbers of volunteers involved in the event delivery are testament to this. Volunteers can take on operational roles or leadership roles. Individuals applying for a leadership role are asked to commit to three years of festivals, which means that experience can be built up over time and in their final year volunteer leaders are asked to mentor their successor. Woodford has a high rate of repeat volunteering (60 per cent) which is testament to the quality of the volunteer programme (Allen et al. 2011).

It seems that local people generally support the expansion of the Woodford Folk Festival as community organisations and the festival continue to work together. According to one community member, "The vast majority of people accept and appreciate the fact that the festival adds another dimension to Woodford" (Suncoast Times 2015).

500-Year Plan

One of the foundations of the Woodford Folk Festival is the embracing of a 500-year plan. This is not a strategic plan as such but more an expression of ideology. The plan in full reads as follows (Aspiration 2010):

> *We recognise, appreciate and graciously receive gifts from our ancestors. We understand these are the gifts of lore and the celebration of our existence.*
>
> *We aim to gift future generations a clean slate: an organisation unencumbered with financial social or environmental debt.*

We'll cultivate a convention of decision making, strengthening through time that will resonate in our work and nurture our future.

We'll plant a forest of goodwill and benefit from its shade.

We will build with the eyes of artists.

We'll provide space for our descendants to meet the challenges of their generations with vigour, courage and imagination and encourage them to celebrate their journeys with levity and frivolity.

The 500-year plan lives in our minds. It is our myth. It is a vision for how we might be and sensed by all who feel our welcome.

According to Deputy General Manager Kim Pengelly, "[the 500-year plan] is not talking about KPIs and dollar figures, it's talking about trading with ethics" (Rawlings 2016). There is a definite sense that the festival aims to be not just a purchase and not just an experience but actually a creative process. "Woodford gives people the opportunity to feel as though they are part of creating something rather than just consuming it" (Pengelly, cited in Rawlings 2016).

Lessons Learned

The case study of Woodford Festival offers many valuable lessons for event organisers. As with other types of organisations, the festival team have been able to build up a sustainable event by making a commitment at all levels to achieving sustainability. The festival management team are both consistent in their mission and in practice in order to achieve this. They have adopted a very long-term plan to develop the festival site and demonstrate the commitment the management team have to land stewardship. It is not enough that the festival does not negatively impact on the event site—it actually improves it, taking on a degraded site and through careful land and wildlife management has begun to develop a wildlife haven. Through the annual tree planting events, the management team are able to engage the whole festival community to achieving this goal.

Their environmental improvements at the site, both during the event and in the longer term include educating staff, volunteers, contractors, vendors, and audiences in sustainable practice. Simple activities such as recycling and composting waste, reusing grey water, and seeking to minimise carbon emissions through transport to the site save money as well as mitigate the event's impact on the local environment.

All this is possible because the festival product is good, with a high proportion of repeat audiences and the festival organisation is financially secure. The event organisers also involve large numbers of volunteers, which contributes to significant financial savings. This has enabled the management team to make such an enormous investment in the site, building up the facilities over a period of years.

The management team have also sought to make the event socially and culturally sustainable through consultation with the Jinibara people, the traditional (indigenous) owners of the land on which the event takes place and the local community. The community provide a source for the extensive volunteer programme as well as a source market for the event audience. Woodford also provides economic benefits for the local area by outsourcing jobs to local community groups and through the enormous economic impact of this annual event.

Sustainability for an event involves not only the event management team but also external stakeholders including audiences, contractors, and vendors. At Woodford, suppliers and contractors are encouraged to use sustainable materials on site and audience members are encouraged to reduce their carbon footprint through sharing transport or using public transport to travel to the event. Educational programmes promoting pro-environmental behaviour for event goers are held at the event and followed up with educational resources on the event website.

Woodford also follows good practice in staffing and volunteer management. The high rate of return for volunteers shows how the programme is well-managed, offering an enjoyable experience to volunteers as well as opportunities for personal development as a volunteer leader. Woodford management team truly adopt a stakeholder approach to managing the event site and the event.

Woodford takes their sustainable agenda further by seeking to be an industry leader, lobbying government for legislative change, and advocating for sustainable events at public forums.

Challenges and Barriers

Events and festivals face a number of specific challenges, which are unique to their time-limited nature and the wide range of stakeholders involved in event delivery. Events and festivals involve many stakeholders including the audience, performers, contractors, and vendors. Getting these stakeholders to engage with the event management's sustainability agenda can be a challenge.

Fig. 31.1 Stakeholders at Woodford festival

Fig. 31.1 shows the different stakeholder groups for Woodford. Woodford Management Team needs to not only ensure that the event on site adheres to sustainable practice but also seek to influence their audience, contractors, and volunteers. A large, high-profile event such as Woodford, with a high level of repeat visitors, can set expectations. Contractors are encouraged to use sustainable products while the event managers promote alternative transport options for audiences to reduce the carbon emissions associated with travelling to the event—frequently the biggest environmental impact of any event. The Woodford Management Team also takes this further by seeking to lobby government and provide educational resources for their audience on their website to reinforce messages from the event itself.

Greenfield events face more challenges than those based within a built venue. Woodford has purchased its own site and been able to develop this over time to make their event more sustainable each year. This is only possible for a regular event with a large turnover. One-off events and smaller, community festivals simply do not have the resources to do this.

Woodford's close relationship with the local community and ability to draw on volunteers are due to the long-term relationships the event team has built up over the years. Holding an event for the first time or in a new location means that these relationships need to be developed. Residents can be hostile towards an event if they perceive that this will have a negative impact on their lives, perhaps through traffic and parking problems or increased litter or noise.

The Woodford management team recognise that their event—where over 120,000 visitors suddenly arrive in rural Queensland for a weekend—has potential negative impacts and have taken time to communicate the longer-term benefits to the local community of these short-term disruptions. The management team attend community meetings and hold consultations with local residents on new developments at the site as a means to engage this important stakeholder.

Events and festivals need to achieve all areas of the triple bottom line. To be truly sustainable, they need to minimise their impact on the environment, engage with the local community, and be economically viable. Achieving all three is challenging.

Conclusions

Events and festivals are growing globally as a means to promote tourism and other business activities. As time-limited phenomena, they create specific challenges for sustainable practice. At the same time, there is growing concern both within the industry as well as from governments and funding bodies to ensure that events limit their negative impact on both the environment and the local community, while still generating economic outcomes such as jobs and investment. The challenge that many events and festivals face is in achieving all aspects of the triple bottom-line approach to sustainability and there are many examples of events that have failed to be economically viable.

Event organisation is further complicated by the large number of stakeholders involved in any event. Event managers need to encourage, influence, or coerce external stakeholders including contractors, suppliers, vendors, performers, and their audience in order to embed sustainability within the event. Real sustainability, as in the case of Woodford Festival, involves long-term planning and action. Again, the time limited nature of events prevents many event organisers from putting into place any plans beyond staging the next event. This is particularly challenging for one-off events.

Finally, the profile of sustainability in the context of events and festivals has grown significantly over the past decade. In part this is due to both industry initiatives and accreditation schemes and awards. However, external pressure has also guided event managers, particularly from governments and funding bodies. Events involve many stakeholders and these stakeholders need to work together to achieve sustainability.

Further Reading

Case, R. 2013. *Events and the Environment*. Abingdon: Routledge.
Holmes, K., M. Hughes, J. Mair, and J. Carlsen. 2015. *Events and Sustainability*. Abingdon: Routledge. (2013).
Jones, M. 2014. *Sustainable Event Management*. Abingdon: Routledge.
Mair, J., and J. Laing. 2012. Exploring Greening in Music Festivals. *Journal of Sustainable Tourism* 20 (5): 683–700.
Raj, R., and J. Musgrove, eds. 2009. *Event Management and Sustainability*. Wallingford: CABI.

References

Allen, J., W. O'Toole, R. Harris, and I. McDonnell. 2011. *Festival and Special Event Management*. Milton: Wiley.
Aspiration. 2010. *About Aspiration—The 500 Year Plan*. http://nr.woodfordfolkfestival.com/__friends/about/.
Australian Population. 2016. *Population of Brisbane.* http://australiapopulation2016.com/population-of-brisbane-in-2016.html.
Getz, D. 2013. *Event Tourism: Concepts, International Case Studies and Research*. Putnam: Cognizant Communication.
Harvey, E. 2009. Greening Live Earth. Long-Term Legacy Implications for the Olympic Games. In *Event Management and Sustainability*, ed. R. Raj and J. Musgrove, 195–205. Wallingford: CABI.
Holmes, K., M. Hughes, J. Mair, and J. Carlsen. 2015. *Events and Sustainability*. Abingdon: Routledge.
IOC. 2012. *Guide on Olympic Legacy*. Lausanne: IOC.
Mair, J., and J. Laing. 2012. Exploring Greening in Music Festivals. *Journal of Sustainable Tourism* 20 (5): 683–700.
———. 2015. Music Festivals and Social Inclusion—The Festival Organiser's Perspective. *Leisure Studies: An Interdisciplinary Journal* 37 (3): 252–268.
Noise11.com. 2016. *Wood Folk Festival Praised for Its Tourism Impact*. http://www.noise11.com/news/woodford-folk-festival-praised-for-tourism-impact-on-queensland-20141218.
Pitts, A., and H. Liao. 2009. *Sustainable Olympic Design and Urban Regeneration*. Abingdon: Routledge.
Preuss, H. 2007. The Conceptualisation and Measurement of Mega Sport Event Legacies. *Journal of Sport and Tourism* 12 (3): 207–228.
Race, R. 2015. Getting Trashed. *Overland*. https://overland.org.au/2015/05/getting-trashed/.
Rawlings, A. 2016. *Special Kind of Folk*. http://profilemag.com.au/special-kind-of-folk/.

Sadd, D., and I. Jones. 2009. Long-Term Legacy Implications for the Olympic Games. In *Event Management and Sustainability*, ed. R. Raj and J. Musgrove, 90–98. Wallingford: CABI.

Suncoast Times. 2015. *Festival Growth Benefits Woodford Community*. http://www.suncoasttimes.com.au/news/festival-growth-benefits-woodford-community/.

Sunshine Coast Daily. 2016. *Record Attendance at Woodford Folk Festival*. http://www.sunshinecoastdaily.com.au/news/woodford-attendance-a-record/2888586/.

Symons, E. 2017. *Woodford Folk Festival by the Numbers*. http://blog.woodfordfolkfestival.com/woodford-folkfestival- by-numbers/.

The Planting Festival. 2016. *Director's Welcome*. http://theplantingfestival.com/about/directors-welcome.html.

Tiew, F., K. Holmes, and N. DeBussy. 2015. Tourism Events and the Nature of Stakeholder Power. *Event Management* 19: 525–541.

Woodford Folk Festival About the Festival. 2016. https://woodfordfolkfestival.com/the-festival/about/.

Woodford Folk Festival Environmental Statement. 2016. https://woodfordfolkfestival.com/the-festival/environmental-statement.html.

Woodford Folk Festival Our Land. 2016. https://woodfordfolkfestival.com/the-festival/our-land.html.

World Commission on Environment and Development. 1987. *Our Common Future*. Oxford: Oxford University Press.

32

We'd Like Our Clothes Back Please! Partnering with Consumers to Achieve Sustainability Goals

Diane M. Phillips and Jason Keith Phillips

Background

"Fast fashion" is a trend in the fashion industry where new fashion trends are created, manufactured, and sold to the masses at cheap prices in a very short period of time. In fact, Zara has increased the speed of bringing a new style to the racks so efficiently that it now takes a mere two weeks to get a new design concept manufactured, distributed, and in the customer's hands (Cline 2012). This new trend is embraced wholeheartedly by the likes of clothing retailers like H&M, Zara, Forever 21, and Charlotte Russe. From the consumer's perspective, quality is no longer a consideration because the new dress or shirt only needs to last until the next new style hits the shelves (Cline 2012). The problem is that this new trend is very unsustainable from both an environmental perspective and from a human perspective.

Environmental Impacts

The average American family spends $1700 USD on clothing per year, and, as a nation, America has over 20 billion items of clothing in its closets (Cline 2012). This works out to be approximately 65 pieces of clothing for every

D. M. Phillips (✉)
Department of Marketing, Saint Joseph's University, Philadelphia, PA, USA

J. K. Phillips
Department of Marketing, West Chester University, West Chester, PA, USA

R. Brinkmann, S. J. Garren (eds.), *The Palgrave Handbook of Sustainability*,
https://doi.org/10.1007/978-3-319-71389-2_32

man, woman, and child in the United States. Slightly worn or out-of-style clothing no longer gets fixed, it gets discarded. Indeed, the US Environmental Protection Agency (EPA) estimates that 85 percent of our clothing gets thrown away instead of recycled or donated. In all, the average American throws away 70 pounds of clothing per year (Council for Textile Recycling 2016). This works out to be 18.2 billion pounds of clothing and footwear going to our landfills every year, only about 13.8 percent of which is ever recovered (EPA 2009).

Another way in which the fast fashion trend is harmful to the environment is the fact that the global textile industry is responsible for an incredible amount of chemical pollution. Cotton makes up 45 percent of all of the fibers used in the global textile industry (Kaye 2013) and is considered by most individuals to be a natural fiber. Unfortunately, this is far from the truth. Indeed, cotton is actually the world's dirtiest crop due to its heavy use of pesticides, herbicides, and fungicides. Although cotton covers only 2.5 percent of the planet's cultivated land, it uses 16 percent of the planet's pesticides (Meyer 2014). Further, 90 percent of the US cotton crop is genetically engineered (Meyer 2014). Since very few genetically engineered crops have been tested for their long-term effects on the environment or human health, this creates another concern for those interested in human health and the natural environment. Another problem with cotton production is that it requires an incredibly large amount of water—20,000 liters of water is required to make one kg of cotton, which is the equivalent of one t-shirt and a pair of jeans (Baerlocher et al. 1999).

Still another top environmental concern is the toxic nature of the dyes and other chemicals that are used in the finishing stages of clothing production. Clothing manufacturing operations in India and China have dumped so much toxic dye and other finishing chemicals into the local waterways that it has destroyed farmland and ruined drinking water (Kaye 2013). Researchers have found that manufacturing and dying operations regularly use chemicals that cause cancer, disrupt hormones, and kill aquatic life. Further, although national governments and industry officials have agreed to limits of the use of these chemicals, manufacturers regularly exceed them (Greenpeace 2012). In a recent study, one particularly harmful chemical, nonylphenol ethoxylate (NPE), was found in approximately two-thirds of garments tested worldwide (Greenpeace 2012). This chemical is so harmful that the EU has banned its use in manufacturing textiles within the EU and has banned any textiles that have been treated with NPE from being imported into the EU. Indeed, officials in the EU have said that importing clothing treated with this chemical

poses an "unacceptable risk" to the EU (Flynn 2015). From an environmental perspective, the effect of the fast fashion craze is enormous.

Human Impacts

From a humanistic perspective, the impact of fast fashion isn't much better. Most garment workers in places like India and Bangladesh make $2/day and work long, back-breaking hours (Ross and Morgan 2015). Many of these workers are young, uneducated women who have few other options to earn a living; the hours are long, safety regulations are lax, and there are few if any opportunities for workers to organize for better wages or working conditions (Ross and Morgan 2015). In January 2014, when garment workers in Cambodia tried to organize a protest for better wages and working conditions, they were shot with live bullets and beaten with clubs. In the end, five people died and dozens were injured (Welsh 2015).

In addition to the long hours and sometimes dangerous conditions, the impact of working in such textile factories on young women is particularly harmful. Many are of childbearing age and are thus exposing themselves and babies to harmful chemicals. For example, chromium 6 is used extensively in tanneries in India. It may damage the liver, causing jaundice and a variety of other ailments (Ross and Morgan 2015). Formaldehyde, which has been linked to cancers like leukemia, is also used extensively in the finishing stages of clothing production (NIOSH 2004).

Finally, the opportunity costs of having so many young women drop out of school so that they can dye, cut, sew, and iron cheap clothing for Western markets is another issue for consideration. Without being able to get sufficient education, these women are less capable of fully engaging with and contributing to business, engineering, medicine, or the arts. Further, it is very unlikely that they will participate in politics, thus ensuring very little representation in local, regional, or national governments. From a more quantitative perspective, there are definite monetary losses involved with women who do not have the ability to collaborate, connect, and lead the global economy. Specifically, denying girls an education and relegating women to low-skilled jobs damages the competitiveness and economic prosperity of a country. Research has shown that when women are given a chance to become educated, there is a 0.2 percent annual increase in GDP for an economy; when women are employed, there is a 20 percent annual increase in per capita income (Matsui 2013). From a human perspective, fast fashion is incredibly harmful.

Case Study: Eileen Fisher

A world away from these troubles, Eileen Fisher did not start out in the fashion industry to change the world. In fact, her first steps into the global fashion industry had quite humble beginnings. It all started in 1984 when she had just $350 in her bank account, but high hopes of making a difference in the fashion world. She was tired of the fashion industry's constant treadmill of new trends, designs, and so on, and she wanted to offer simpler, more timeless designs (Caplin 2004). She brought four of her designs to a New York show, sparked some interest, and walked away with $3000 in new orders from some of the top-name retailers in the city. Three months later, orders were coming in for $40,000 (Caplin 2004). EILEEN FISHER, Inc. was born.

Today, EILEEN FISHER has annual sales of $350 million and more than 60 stores in the United States, Canada, and the United Kingdom. EILEEN FISHER also sells its clothing through a variety of upscale retailers, such as Nordstrom and Neiman Marcus. The company's closest competitor is Donna Karan (at $443 million per year in sales) (Hoover 2016). With its clean and simple aesthetic, high-quality materials, and social and eco-conscious manufacturing, the clothing appeals primarily to upscale professional women in their 40s and 50s.

The styles themselves are timeless and represent fundamental values that are exactly the opposite of the fast fashion trend of buy-wear-throw away. They do not change wildly from one year to the next and are specifically designed to be timeless. Classically designed pants, tops, and dresses are made from top-quality materials that can be worn alone or paired with several other items. They can be worn across a variety of different seasons and can be either "dressed up" for a night out or "dressed down" for a more casual occasion. They can also easily change or adapt to a woman's own style with the addition of some jewelry, a scarf, and so on. In addition, most of the clothing itself is made primarily from natural and organic fibers; the dyes and finishing chemicals have been tested to be safe for the environment and human health. For example, the boiled wool kimono jacket has been finished without chlorine, and the dyes that are used have been tested for their safety (www.eileenfisher.com n.d.). Finally, the clothing is very easy to care for and wash. The clothing can be washed at home instead of dry-cleaned, lasting years instead of just a few seasons (Binkley 2009). Fisher explained, "from day one, I wanted to help people simplify their lives. That's what my clothes are about" (Canabou 2001) (Fig. 32.1).

Fig. 32.1 EILEEN FISHER boiled wool kimono coat

Although a short sleeve shirt can cost more than $100, EILEEN FISHER is the luxury brand that doesn't want to look like a luxury brand. With everything that goes into the design and production of a given piece of clothing, it is certainly worth the investment for many customers. EILEEN FISHER proudly proclaims that:

> *Your choice has power: by choosing clothes that are responsibly made, you make a statement about what you value. It's a small act, but one that changes the way business is done, one purchase at a time. (www.eileenfisher.com,* n.d.*)*

What Makes EILEEN FISHER Different?

The accomplishments of EILEEN FISHER are certainly impressive. However, many companies are headed by CEOs that have a strong sense of environmental and social justice. Many companies use organic materials in the manufacture of their products and support favorable working conditions for their workers. EILEEN FISHER isn't all that different. Or, is it? What makes EILEEN FISHER different is the fact that this value system fully permeates all aspects of her business. Indeed, the commitment of the company to its value system is clearly evident from the corporate mission, the emphasis on work/life balance, her succession plan, and the transparency by which Fisher runs her operations.

Corporate Mission

It is interesting to note that neither clothing nor fashion is mentioned anywhere in the company's mission or guidelines. Instead, it is clear to see that the employees, the local community, and the environment are the main focus of the organization. The clothing acts as the *vehicle* by which these values become actualized. Indeed, "we believe that building partnerships with our suppliers, customers and communities will affect positive change in our industry and in the world, turning business as usual into business as a movement" (www.eileenfisher.com n.d.).

This forward-thinking corporate mission has helped the management team develop a set of guidelines that help direct its decision-making. On a day-to-day basis, working at corporate headquarters is an enriching experience. For example, the corporation gives $1000 to each employee annually to help them fulfill "wellness objectives," such as yoga classes, meditation classes, gym memberships, or massage. It gives another $1000 annually for educational activities, ranging from creative writing classes, to horseback riding, to language classes (Hall, 2006). The office itself provides recycling bins, filtered water dispensers, ceramic (not Styrofoam) cups for hot beverages, weekly deliveries of organic food from local farms, and periodic emails discussing, for example, socially conscious gift ideas for the holidays or environmentally friendly vacation spots for summer getaways (Hall 2006) (Table 32.1).

The mission and guidelines also direct many of the outreach initiatives that Eileen Fisher has created and grown throughout the years. For example, EILEEN FISHER created a Women's Business Grant Program to empower women-owned businesses as well as the Activating Leadership Grant to fund

Table 32.1 Mission statement and guidelines

Corporate mission	*To inspire simplicity, creativity, and delight through connection and great design*
Overall goal	*To have our mission drive our business and our profitability foster our mission*
Mission practices	• individual growth and well-being • collaboration and teamwork • joyful atmosphere • social consciousness (Hall 2006)
Social consciousness priorities	• individual well-being • support of women • environmental sustainability • human rights in the workplace (Hall 2006)

programs that "activate leadership qualities in women and girls" (www.eileenfisher.com n.d.). In 2016, with the Council of Fashion Designers of America, the organization launched its Social Innovators Award. This award is designed to give fashion design students a chance to invent a new process, design, or concept in order to help others (PR Newswire 2016).

Work/Life Balance

Buying and wearing a piece of EILEEN FISHER clothing is more about demonstrating your values, than about showing off a designer label. This concept of "being mindful" is important to how Eileen Fisher runs her business. At her global headquarters in Irvington, New York, each day starts out with a quiet chime, to remind employees to have a moment of silence before the day starts (Casabona 2012). Employees take part in yoga classes (Francis 2007), get massages, participate in creative "fun play" exercises, and eat organic food at most of their big meetings (Hall 2006). In the end, the goal is to provide a workplace environment that mirrors this simplicity and concern for others. The workplace fosters creativity and collaboration, comfort and connection.

Eileen Fisher herself takes this advice to heart. After several years in the high-fashion industry, she felt as if her life was out of balance. She had a long commute to work every day and got to spend very little time with her children. Deciding it was time for a change, she and her family moved four blocks away from the corporate offices in Irvington, NY. While they were young, Fisher could walk her children to school in the morning and then be there for them when they came home from school. Fisher and her employees also support the vibrant local community by frequently visiting local stores, restaurants, parks, art studios, and coffee shops (Canabou 2001). All employees are encouraged to learn about and become involved in the local community.

When new employees become a part of the EILEEN FISHER team, they do more than just join in the activities of recycling, using ceramic coffee mugs, and taking yoga classes. Indeed, the organization is committed to helping each new employee become fully integrated into the value system and purpose of the organization. The Social Consciousness Team has a four-step process, "The Employee Life Cycle," by which new recruits are introduced to these values and then hopefully embrace them enough to become active advocates for those values. This Social Consciousness Team helps to fully integrate social consciousness into every part of an employee's day (Hall 2006). Social consciousness infuses everything that is done at EILEEN FISHER and encourages all employees, from interns all the way up through the executive team, to think about the human and environmental implications of their decisions (Hall 2006).

Succession Plan

There comes a time when every entrepreneur starts to think about his or her legacy. Eileen Fisher started the company in 1984 and wanted to ensure that the values of her organization would be maintained after she decided to eventually retire and hand over the leadership reins to someone else. So, several years ago, she started to consider a variety of different options. One idea in the beginning was an Initial Public Offering, another was selling to Liz Claiborne (Inc. 2015). Fisher recalled, "I just remember sitting at a table…with the president of Liz Claiborne. And I said, 'so why are you interested in my company?' She said, 'we have a mandate to grow 10 percent a year and we can't do that unless we buy companies.' And I was like, 'Oh! So it's all about money again. What about the clothes?'" She elaborated about her feelings at the time, "there isn't an empty company shell owning this, but this will be owned by the people who have put their blood, sweat, and tears into it; by the people who love it and care about it and are thinking about it" (Inc. 2015). She also discarded the idea of selling the company to an outside investor.

In the end, Fisher decided to "keep the company intact with the people who've grown it" (Francis 2007) and created an employee stock ownership plan. Fisher herself walked away with $30 million in tax-free funds, retained 70 percent of the business, and shifted 30 percent ownership to her employees. Although employees are consulted on most of the bigger issues facing the organization, Eileen still makes the final call (Francis 2007) and maintains the title of Chief Creative Officer (Inc. 2015). Today, 624 employees own stock in the company, and EILEEN FISHER makes annual contributions to the plan, equivalent to about 14 percent of employees' compensation (Francis 2007).

Transparency

Management at EILEEN FISHER doesn't just talk about all of the wonderful initiatives they're promoting, they provide evidence of all of their progress. Working under a philosophy that it is better when more businesses operate sustainably, EILEEN FISHER regularly shares the results of its initiatives with a variety of stakeholders. The goal is to get the word out, not keep their ideas and findings to themselves. One way in which they are transparent is through the company website. The "behind the label" tab provides a wide variety of information, including details about specific manufacturing operations, the supply chain, and human rights (www.eileenfisher.com n.d.). EILEEN FISHER also provides labels on all of the clothing, describing the basics of how it was made, whether or not the fabric is organic, and whether chemicals, dyes, and so on, were used in any part of the process.

EILEEN FISHER has also achieved two very impressive external certifications for its work. The first is SA8000 certification. This certification is awarded by Social Accountability International, a global organization created to encourage and facilitate socially conscious business operations. The criteria for SA8000 come from the UN Declaration of Human Rights, conventions of the International Labor Organization, United Nations, and national laws (www.sa-intl.org n.d.). EILEEN FISHER has also been B-Corp Certified since 2015. With B-Corp Certification, organizations are assessed on five key dimensions: environment, workers, customers, community, and governance. The median score for organizations that have completed the assessment is 55. EILEEN FISHER has achieved an overall score of 82 (www.bcorporation.net n.d.). Some highlights of these assessments are that greater than 75 percent of the executives at EILEEN FISHER are women, more than 50 percent of its input materials have some sort of environmental certification, and more than 75 percent of its energy is generated from renewable resources (www.sa-intl.org n.d., www.bcorporation.net n.d.). This transparency allows important stakeholders to learn about their continuous progress toward sustainability.

EILEEN FISHER RENEW: Partnering with Customers

What is the next step for EILEEN FISHER? How can this relatively small fashion house continue to maintain the margins it needs, provide outstanding pay and benefits to its employees, design and manufacture top-quality sustainable clothing, and be innovative in supporting impactful socially-conscious projects? The answer: RENEW, an initiative that was started in 2009 to

fully integrate both the environmental and human element into the process of product design, production, and reuse (PR Newswire 2016). RENEW claims that, "where others see waste, we see possibility" (www.eileenfisherrenew.com n.d.). RENEW engages in a fully integrated cradle-to-cradle process in its product design, production, and eventual consumer use and reuse. In short, RENEW takes back used and slightly worn EILEEN FISHER clothing, fixes it or repurposes it, and sells it back to customers at stores located around the country. There are two RENEW stores (in Seattle and New York), 11 other stores around the United States that sell the products, numerous short-term pop-up shops around the country, and an online store. RENEW's mantra is "Wear. Love. Repeat." To date, RENEW has received 800,000 items, which works out to be 800 pieces per day. All net profits go to "programs that support positive change for women, girls, and the environment" (www.eileenfisherrenew.com n.d.). The website proclaims:

> *By taking responsibility for the lifecycle of our clothes, we're patching up the holes in a flawed apparel industry and setting a new standard for sustainability. But we can't do it alone. Every time you choose to bring your clothes back or shop Renew, you're helping us design a future without waste*. (www.eileenfisherrenew n.d.)

The Original Cradle-to-Cradle Concept

Cradle-to-cradle is a design and manufacturing philosophy that has a goal of zero waste. As it was originally conceived, it is primarily focused on resources and waste. It suggests that product designers need to consider what will happen to their products during manufacturing, consumer use, and disposal. Post-consumer products that are broken or out-of-fashion can be pulled apart and made into something new. These post-consumer materials now become the raw materials for new products. Thus, raw materials can get endlessly recycled into new items and the concept of "waste" is eliminated (McDonough and Braungart 2002).

Organizations wishing to develop a cradle-to-cradle process need to start with a whole-system perspective. First, at the beginning of the process, designers need to carefully consider the raw materials that will be used in the process. Are they sustainable? Are they sourced in a sustainable manner? Will there someday be post-consumption demand for these raw materials? The second consideration is what happens during the manufacturing part of the process. The product design team needs to ensure that manufacturing is done in a sustainable way. Is renewable energy used to power the machinery and

transportation of materials? Are non-petroleum-based products used throughout the process for lubrication, cleaning, and so on? Is waste minimized or eliminated? The third consideration for the product design team is what will happen when the consumer uses and then disposes of the product. Can the product be easily pulled apart by the consumer? Can the consumer easily send it back to us or drop it off at a store? Thus, a shift to a cradle-to-cradle system requires that the design and management team take a whole-system perspective (Fig. 32.2).

The cradle-to-cradle process has several distinct advantages for manufacturers:

- It keeps harmful waste out of the environment.
- It reduces disposal costs—less waste material needs to be hauled away.
- It provides a potential new source of revenue—other organizations may be interested in purchasing these materials.
- It helps build human capital—employees become more engaged in the organization and could potentially receive higher wages because of new skills learned.
- If the organization collects its own used products, it can be confident that the material is of good quality—after all, it originally manufactured those products.

Importantly, cradle-to-cradle also represents a paradigm shift in how consumers think about their own role in sustainable consumption. In essence, consumption is no longer a bad thing when cradle-to-cradle is utilized.

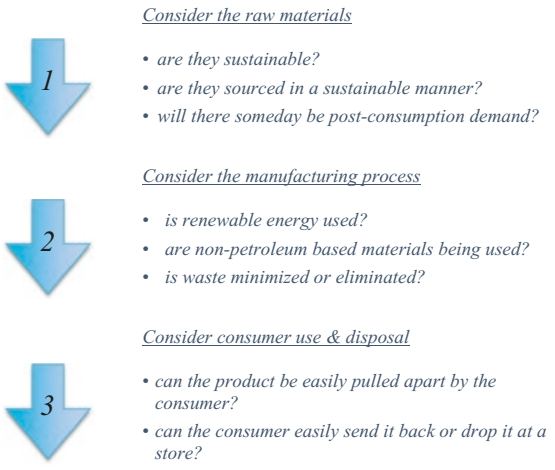


Fig. 32.2 Cradle-to-cradle's whole-system perspective

Previously, a lot of pressure had been placed on consumers to engage in sustainable consumption by cutting back on their consumption habits or by purchasing "green" products that were sometimes of an inferior quality. Now, however, cradle-to-cradle lifts the burden on consumers and allows them to have fewer disruptions to their normal shopping and consumption habits.

One Step Further

This is where RENEW comes in. RENEW takes the concept of cradle-to-cradle one step further. Not only does it consider all of these sourcing, manufacturing, and consumer-use issues, it also considers the very real human impact at each step of the process. Consumers are indeed key partners in the entire process. The concept for RENEW was developed and refined out of a recent Social Innovators Award, from EILEEN FISHER. Three fashion design students wrote a proposal and then developed a creative plan to engage consumers, reduce waste, create new skilled jobs, support a host of charities, and provide a new group of customers with access to the EILEEN FISHER label at a fraction of the price. Importantly, they figured out how to scale the process (PR Newswire 2016). The process all starts with sourcing of raw materials. Here, RENEW relies on the help of EILEEN FISHER customers, many of whom are already aware of the brand's values of sustainability, simplicity, empowerment of women, and human rights. Customers bring their old EILEEN FISHER clothing back to the stores or ship the items to one of two different locations. In exchange for their donation, customers receive a $5 coupon for each item they donate. Customers are also encouraged to support a variety of EILEEN FISHER's other charities and initiatives. They can become involved in different actions or can donate money to different charities. Customers are viewed as partners in the quest for sustainability. Stores often have special events like guest speakers, concerts, or even sewing lessons. Speakers talk on a multitude of topics, but often the topics gravitate toward issues of environmental and social justice. The goal is to get customers to become involved in these movements by donating their time, skills, and money to these worthy causes (www.eileenfisherrenew n.d.).

Once RENEW receives donated clothing, it is sorted into four different piles, and, depending on the work that needs to be done, the skilled people at RENEW will find something to do with the clothing:

- Small stains—items are overdyed with plant-based dyes.
- Small rips, tears, or flaws—items are sewn, buttons are replaced, or seams are mended.

- Bigger flaws—these items are mended to create one-of-a-kind clothing or repurposed into other items such as purses or pillows.
- Really big flaws—about 25 percent of the clothing that is donated is damaged beyond repair. When this happens, the sections that are still salvageable are cut away, and the rest of the scraps are saved for inputs into the new proprietary fabric manufacturing process.

Although the process is proprietary for now, experts at EILEEN FISHER have revealed that they are partnering "with like-minded brands to invest in innovative technologies that create new fibers from textile waste" (www.eileenfisherrenew.com n.d.). This new process allows RENEW to scale the process so that it can be accomplished more efficiently and with greater quantities of materials. RENEW considers both the environmental and the human implications of its operations—and it is now capable of scaling its operations to make the cradle-to-cradle concept fully actualized.

Although RENEW is certainly not the first clothing brand to offer its second-hand or repaired clothing for sale, it is the first to create a scalable process to do so. Previously, repairs to damaged clothing were done one at a time, a very time-consuming and labor-intensive process. Now, the work is done in batches, making production much more efficient (PR Newswire 2016). An important part of what makes this cradle-to-cradle process work is that the materials in the original garments were of very high quality to start, thus making it quite easy to produce a second generation of high-quality items (Fig. 32.3).

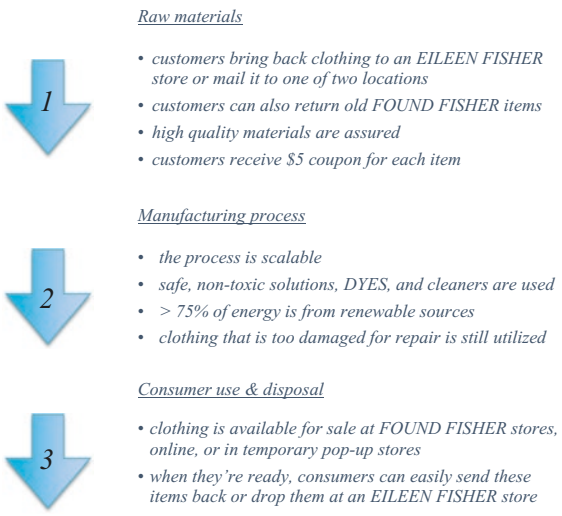


Fig. 32.3 RENEW's cradle-to-cradle approach

It is important to note that this process engages the human element in several important respects. Customers are fully engaged in each part of the process by providing feedback on product design, use, return, and reuse. Clearly, if customers didn't return the product, RENEW would not be possible. In addition, other key stakeholders play a role in the process too. First, the process itself was proposed by the recipients of the Social Innovator Award, three young design students trying to make their first foray into the fashion world (PR Newswire 2016). Second, the manufacturing process itself, though efficient, still requires the expertise and talents of skilled workers. These new workers have jobs and benefits that they didn't have before. Third, RENEW engages the community by contributing to a variety of charities, many of which focus on social and environmental justice, as well as leadership and the empowerment of women and girls (www.greeneileen.org n.d.).

Conclusion

EILEEN FISHER is the antithesis of the current trend of fast fashion. Its purpose is to change the world for the better by empowering customers, engaging employees, and supporting the community. At the same time, management realizes that a healthy planet is necessary for healthy people and a healthy economy. From the beginning, EILEEN FISHER has been more concerned about empowering the customer and caring for the planet than it has been about turning a profit. In its latest innovation, RENEW has adapted the cradle-to-cradle philosophy to incorporate the human element at each step. Importantly, by partnering with other organizations, the process has been improved so much that it is now scalable. Although many previous organizations have utilized cradle-to-cradle concepts (McDonough and Braungart 2002), none have been able to scale their operations to perform these tasks with large quantities of raw materials, both quickly and efficiently. RENEW is truly innovative in its ability to do so.

Lessons Learned

- Sustainability isn't a one-size-fits-all solution. Indeed, every organization approaches it in a unique and different way.
- Sustainability is never an end goal. The main goal is continuous improvement. Technological advancements and constant innovations always provide new possibilities for incremental improvement.

- Sustainability solutions should be shared with business partners and other organizations so that, in the end, an entire sustainable economy is achieved.
- Customer involvement is essential.
- Unless an organization can scale its production, even the best ideas to save the environment or help humankind are just hobbies.

References

www.bcorporation.net. n.d.
www.eileenfisher.com. n.d.
www.greeneileen.org. n.d.
www.sa-intl.net. n.d.
Baerlocher, Christine, Richard Holland, and Biksham Gujja. 1999. The Impact of Cotton on Freshwater Resources and Ecosystems: A Preliminary Synthesis. *The World Wildlife Federation,* Background Paper. May 1999.
Binkley, Christina. 2009. On Style: Death to Discounts? The Designers Rebel. *Wall Street Journal*, Eastern Edition: D1. April 16.
Canabou, Christine. 2001. Simplicity by Design. *Fast Company* 50 (September): 62.
Caplin, Joan. 2004. Eileen Fisher. *Money*, *7*(33): 51. July
Casabona, L. 2012. Fisher Advises Marymount Students. *Women's Wear Daily* 203 (94): 8.
Cline, Elizabeth. 2012. *Overdressed: The Shockingly High Cost of Cheap Fashion*. New York: The Penguin Group.
Council for Textile Recycling Textile Recycling Issues Infographic, Council for Textile Recycling. 2016. www.weardonaterecycle.org. Accessed 28 Aug 2016.
EPA. 2009. Municipal Solid Waste in the United States: Facts and Figures, The Environmental Protection Agency, EPA530-R-10-012, 81–82. December 2010.
Flynn, Valerie. 2015. EU Countries Agree Textile Chemical Ban. *The Guardian*, July 21.
Francis, Theo. 2007. Inside Eileen Fisher's Employee Stock Plan. *Wall Street Journal*, Eastern Edition: B1. January 22.
Greenpeace. 2012. *Toxic Threads: The Big Fashion Stitch-Up*. Amsterdam: Greenpeace International.
Hall, Amy. 2006. Engaging Employees in Social Consciousness at Eileen Fisher. *Journal of Organizational Excellence* 25: 45–52.
Hoover's. 2016. EILEEN FISHER, Hoover's Inc., a D&B Company.
Inc. 2015. Eileen Fisher: "The Hard Road to Learning What Really Matters." *Inc. Magazine Videos*, February 2. https://www.youtube.com/watch?v=lqs1MzowSw4. Accessed 18 Aug 2016.
Kaye, Leon. 2013. Clothing to Dye For: The Textile Sector Must Confront Water Risks. *The Guardian,* August 12.

Matsui, Kathy. 2013. The Economic Benefits of Educating Women. *Bloomberg,* March 7. http://www.bloomberg.com/news/articles/2013-03-07/the-economic-benefits-of-educating-women. Accessed 29 Aug 2016.

McDonough, William, and Michael Braungart. 2002. *Cradle-to-Cradle: Remaking the Way We Make Things*. New York: North Point Press.

Meyer, Melody L. 2014. Chemical Cotton. *The Rodale Institute*. February 4. http://rodaleinstitute.org/chemical-cotton/. Accessed 8 Aug 2016.

NIOSH. 2004. *Worker Health Study Summaries: Garment Industry Workers (2) Formaldehyde*. Cincinnati: The National Institute for Occupational Safety and Health.

PR Newswire. 2016. *Eileen Fisher, Inc. Debuts Limited-Edition 'Remade in the USA'*. Collection at Brooklyn Pop-up Shop, PR Newswire. http://prnewswire.com/news/eileen+fisher%2C+inc. Accessed 28 Aug 2016.

Ross, Michael, and Andrew Morgan. 2015. *The True Cost: Who Pays the Price for Our Clothing?* Sherman Oaks: Blue Frog Films.

Welsh, David. 2015. Fair Trade for the Global Garment Industry. *The New York Times*, May 20. http://www.nytimes.com/2015/05/21/opinion/fair-trade-for-the-global-garment-industry.html?_r=0. Accessed 28 Aug 2016.

33

Green IT: Hofstra University's Information Technology Upgrades Created Unplanned Sustainable "Green Benefits" by Increasing Efficiency and Reducing Costs

Margaret Linehan and Catherine Fisher

Introduction

Sustainability at its core is about respect and fairness. Sustainable development was defined as "development that meets the needs of the present without compromising the ability of future generations to meet their own needs" (World Commission on Environment and Development 1987, 41). Information Technology (IT) intersects with sustainability on many levels, some positive, some not. IT has been defined as technology involving the development, maintenance and use of computer systems, software, and networks for the processing and distribution of data (Information Technology Definition by Merriam-Webster 2017). IT has enormous impacts on the resources of the planet. It has globalized both friendship and finance, and its influence over the planet, people, and profit continues to grow. Universities and businesses staff their IT Departments with trained technicians to provide support for hardware, software, and client services issues. IT managers have the ability to transform IT and to become more sustainable by initiating programs that reduce the negative impacts to the planet while improving the efficiencies of the users. This case study describes how personnel at Hofstra University by focusing on efficiency

M. Linehan (✉)
Social Impact Exchange, New York, NY, USA

C. Fisher
Education and Technology Research Services, Hofstra University, Hempstead, NY, USA

R. Brinkmann, S. J. Garren (eds.), *The Palgrave Handbook of Sustainability*,
https://doi.org/10.1007/978-3-319-71389-2_33

and cost savings have advanced sustainability in the IT Department and as a result have shifted the perception of sustainability within the department.

Background

Before examining the Hofstra case study, a description of IT data access methods, a summary of the negative impacts from IT, and a rationale for Green IT are presented as background.

IT Data Access Methods

Within IT, there are numerous avenues to access data. The following explains three ways to access data. The first is the traditional desktop and laptop computer. A university classroom may have a desktop computer which consists of a monitor, keyboard, a mouse, and a central processing unit (CPU). When the user hits the power button to turn on the computer, it turns on the operating system (OS) bringing a copy of the file from the hard drive to the random-access memory (RAM). The hard drive is a permanent memory storage unit and retrieving data from the hard drive can be a slow process. This is why the OS is moved to the RAM. The RAM does not store any data; consequently RAM can operate with greater speed when connecting the OS to the CPU, the brains of the computer. These work together to follow instructions received from the user through the keyboard, mouse, and on-screen pointer. In addition to user files, applications such as Windows Microsoft Word™ can be stored on the hard drive. The computer has a network interface card that allows for access to the internet through a router by connecting Internet Protocol (IP) addresses. Laptops whether in a classroom or at home have the same functionality as desktops with limits relating to various component sizes (Rouse 2014, 2016a, b).

A second IT data retrieval method is referred to as a virtual desktop infrastructure (VDI) or virtual machine. VDI does not require a CPU but rather only a monitor, a keyboard, and a mouse. All the hardware and software systems that run the computer are located in a server room, which, in this case study, is located on the campus site, but the server can actually be anywhere in the world. The VDI works with a software program, known as a "Hypervisor," which creates both a virtual CPU and software applications on a physical hardware called a host server (Wein 2017; Kleyman 2012). Numerous virtual machines can be added to the host server. And if a hardware problem occurs

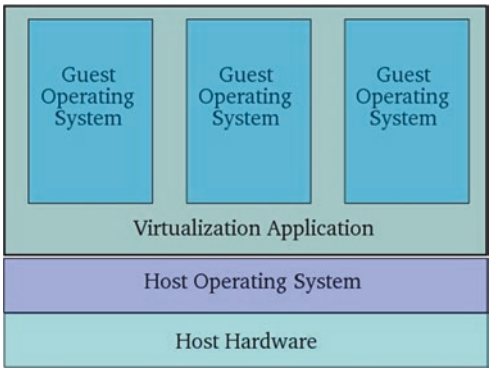


Fig. 33.1 "An Overview of VirtualBox 2." An Overview of VirtualBox 2 – Virtuatopia. March 4, 2008. Accessed October 1, 2017. http://virtuatopia.com/index.php/An_Overview_of_VirtualBox_2

on the host server, the virtual machines can be moved to another host system without any disruption to the user. When the student user logs in with their user login and password, the host server recognizes their virtual machine configuration and connects them to their permissioned sites. It is as if their desktop has its own CPU containing all the pieces described above but it is actually a software program operating on a server that mimics the desktop system previously described. The user sitting at the VDI system only activates their RAM. Unless that user stores her data to a student network account or saves it in some other way (i.e. on an external hard drive), it will be lost (Fig 33.1).

In addition to creating virtual machines with their own (guest) CPUs for students, the virtualization software can create a host hardware server that can create virtual servers. For example, a host server can accommodate guest servers that could provide network connections or be dedicated to a single database file such as oracle (Wein 2017; Kleyman 2012; Chrobak 2014, 118–120).

Cloud retrieval is a third method of retrieving data. While universities have in-house servers, there are non-university servers that could also be utilized. Obtaining data over the internet is considered cloud computing. According to IBM, "cloud computing, often referred to as simply 'the cloud', is the delivery of on-demand computing resources-everything from applications to data centers—over the internet on a pay-for-use basis" (IBM - What Is Cloud Computing? 2016; Griffith 2016). Cloud services are broken down in three basic areas, Software as a Service (SaaS), Infrastructure as a Service (IaaS), and Platform as a Service (PaaS). Microsoft Windows 365™ is an example of a SaaS product (Vladimirskiy 2016). Amazon Web Services (AWSs)™ is an example of both IaaS and PaaS. AWS customers can choose to utilize infra-

structure alone, or they can purchase a complete package where Amazon manages the customer's product. Cloud computing is always available; it can be accessed any time a computer login occurs. It enables everyone to connect with everything by whichever device is at hand—laptop, cellphone, tablet, desktop. In the early stages of the internet, connection was similar to a telephone conversation with two parties at each end of a wire connection. Today, a website is a pass through that can link to a multitude of network connections so vast that the word cloud is used to define them (Amazon Web Services (AWS) - Cloud Computing Services 2017) (Fig. 33.2).

The three IT methods of achieving data retrieval show a progression of efficiency, cost savings, and sustainability. In the first example, in a classroom of 20 students, 20 CPUs would be required. Instead, with a VDI configuration, there would be no individual CPU in the classroom. Twenty less CPUs would be manufactured reducing energy requirements, both in manufacturing and use, greenhouse gases (GHGs), and mining of rare earth elements. This approach provides sustainability and efficiency with in-house IT technicians able to quickly address any problems from the server end. Sustainability and efficiency are intertwined in the cloud since the client only purchases the needed services (cost savings). Hofstra University's IT Department started with a vision of reducing costs and increasing efficiency and while not in the original plan are "greening" their university's IT.

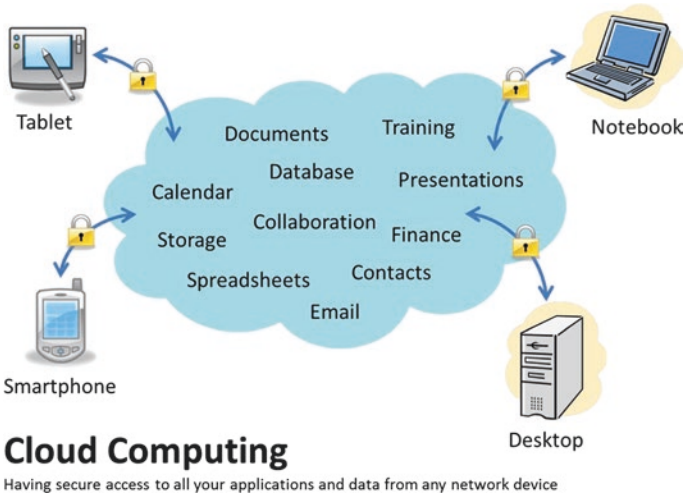


Fig. 33.2 "European Commission Takes Leap to Boost Cloud Computing." 2013. *EU Reporter*. October 28. https://www.eureporter.co/frontpage/2013/10/28/european-commission-takes-leap-to-boost-cloud-computing/

Negative Impacts from IT

IT connects individuals, schools, businesses, and governments with real-time accessibility. But there is a cost. IT equipment is manufactured using earth minerals or rare earth elements (REE). Mining is difficult due to sparse concentration in any one vein. For example, neodymium, a REE used in hard drives, is a very small percent of any extraction. The extraction process produces a large amount of toxic sludge containing thorium and sometimes uranium (Lifton 2011). This extraction causes environmental damage to areas surrounding the mines. Balyun-Odo, an open air mine located near the city of Bataou in the Inner Mongolia region of China, produces nearly 95 percent of the world's rare earth minerals (Graham 2015). The waste from this mining operation is dumped into a human-made lake which was created in 1958 for this purpose. "For every ton of REEs taken from the ground, there are 340,000 to 420,000 cubic feet of waste gas containing dust concentrate, hydrofluoric acid, Sulphur dioxide and sulphuric acid released. Additionally, approximately 2,600 cubic feet of acidic waste-water and about a ton of radioactive waste residue are also produced" (Graham 2015). The size of the lake is approximately three times the size of New York City's Central Park (Ives 2017).

Taiwan companies own over 90 percent of laptop manufacturing and their plants are predominantly located in western China (PR Newswire 2012). When a laptop's components are manufactured in a factory that receives its electricity from a coal generating plant, the supply of fossil fuels is reduced and carbon dioxide (CO_2) is emitted. Between 2006 and 2010, 73.45 percent of China's electricity was generated by thermal power (Zhou et al. 2015). Thermal power generation creates electrical energy by burning coal, oil, gas, and other fuels (Zhou et al. 2015). "'The reality is that no other technologies—wind, solar, gas, hydro, and nuclear—represent a viable alternative for China in the near or medium term,' the analysts said, emphasizing that 'all other technologies are dependent on intermittent or limited resources'" (Corazon Aureus 2014). China, in 2005, produced 68 percent of the world's PC production (Dean and Tam 2005). Production of PCs has slowed recently but is offset by the increase in the production of tablets. In 2011, greater than 90 percent of computer products were manufactured in China (Schiavenza 2013). Supply chains that are not sustainably focused add to the diminishment of the planet's fossil fuels. Petroleum fuel releases GHGs into the environment. With international cargo and plane travel this has a geographical impact which cannot always be clearly measured (Rodrigue 2017).

In addition, GHGs are emitted through both the manufacturing and use of IT. For a 17-inch desktop, the energy employed in manufacturing is 81 percent compared to 19 percent in usage (Williams 2004). For laptops, the amount of CO_2 emitted during the manufacture of a laptop is close to that of the manufacture of a refrigerator which has a much greater life span (Cooney 2011). Production and use of laptops and desktops add to GHG emissions in the atmosphere. According to the Goddard Institute for Space Studies (GISS), the planet has been warming since 1880 with the greatest temperature increase occurring from 1975 to the present. A small change makes a big difference. "A five-degree drop was enough to bury a large part of North America under a towering mass of ice 20,000 years ago" (Carlowicz 2010). GHGs have increased due to industrialization and are the major contributors to global warming (Horton 2012). The most damaging GHG is CO_2 (United Nations Framework Convention 2014). CO_2 is released by burning fossil fuels when manufacturing hard drives, LEDs, and other computer pieces. For 2014, 81 percent of the GHGs produced in the United States released 6870 million metric tons of CO_2 into the atmosphere. Records indicated that for 2014, the largest percentage (30 percent) of GHGs being released into the atmosphere was from the electricity sector (United States Environmental Protection Agency 2017).

Electricity generated to power computers, whether laptops or desktops, continues to increase. Even when a computer is in sleep mode, it draws electrical power. Depending on the battery, a laptop that is never unplugged will consume approximately 235 kilowatts a year (Schlossberg 2016). A large amount of electricity is consumed through heating ventilation and air conditioning units (HVAC) that are required to cool data centers. HVAC systems can use 25–40 percent energy load (US government Office of Energy Efficiency. Department of Energy 2017). Data center servers and computing equipment can generate so much heat that a Green Grid Association in 2007 developed the power usage effectiveness (PUE) measurement. The PUE formula is the total facility energy divided by the IT equipment energy with the ideal number being 1.0 and the average approximately 1.8 (Barrass et al. 2012). In addition to high amounts of energy consumption and the release of GHGs, some HVAC units still contain chlorofluorocarbons (CFCs) which damage the ozone layer (US EPA 2015).

Lastly, when the life span of IT systems is at its end, these products must either be disposed of or recycled. New York City ships to sites in Pennsylvania, Ohio, and Virginia (Iannucci 2006). Most US municipalities have recycling laws in effect (DSNY - About - Recycling Laws For Residents 2015; NYC Sanitation - New Business Recycling Rules 2017). Within New York State it is against the law to dispose of electronics in the trash (Recycling Consumer Electronic Waste - NYS Dept. of Environmental Conservation 2015). Many

municipalities have drop-off sites for e-waste (DSNY - Zero Waste - Electronics 2015). When electronics are dumped into landfill, the chemicals, mercury, chromium, lead, and brominated flame retardants, used in their production, leech into the soil, contaminating the earth and releasing GHGs (Urban Mining 2015). Recycling e-waste would reduce the need to mine for rare earth minerals.

Recently news headlines seem to reveal on a daily basis that another major corporation has had it database hacked. Personal information, such as credit card numbers, date of birth, and social security information, is now stored on IT databases. Numerous corporations have had their databases hacked in 2017 and the number of security breaches continues to increase. The US Congress is investigating the Equifax breach, but in the current political climate, it is unlikely there will be any new consumer protection legislation passed (Daitch 2017; Cowley et al. 2017). There is nothing sustainable about a database that has been corrupted through hacking. Organizations that are hacked may face a decrease in profits with users/customers canceling their services and an increase in costs due to increased staff hours necessary to repair the damage. IT Firewalls have to become more efficient at identifying and restricting malignant data, and as the following case study proves, efficiency increases sustainability.

Social media exists everywhere and in all forms. Data connected to the internet is basically impossible to remove. People have posted comments and photos that have caused them to lose job opportunities or even be dismissed from a position. Online firestorms are intense full-blown aggressive responses that can have negative consequences if the information is false (Kelly 2013). Fake sites can be set up with fake information such as the Russian Facebook sites which have had serious political repercussions (Shane 2017). A negative impact of cyberbullying is the potential to lead to depression in children who have been bullied (Rost et al. 2016; Hamm et al. 2015). Social media creates and sustains divergent communities, most offering positive messages. When the word "sustained" is used in court by a judge, it is meant to validate a statement (Hill and Hill 2017). Fallacious media is never sustainable.

Rationale for Green IT

"Efficient IT=Green IT, it is just that green is a genuine beneficial by-product of the primary goal, delivering the right amount of IT at the right time" (Gabriel 2008, 230). Research data supports the correlation of IT energy efficient solutions and sustainability (Mithas, Roy, and Khuntia 2010).

Specifically, there is research that less energy used in a data center saves the natural environment from further depletion of the resources necessary to produce the energy required to run a data center (Erol-Kantarci and Mouftah 2015). Throughout the article by Erol-Kantarci and Mouftah, there is no distinction made between being energy efficient and the use of the word green. Being efficient is being sustainable. And Hofstra University demonstrates this correlation of efficiency and Green IT in numerous ways but particularly their transition to VDIs and AWSs.

Case Study

Hofstra University, founded in 1935, is a private higher education institution in Hempstead, NY. It is situated on 240 acres and is a national arboretum with over 12,000 evergreens and trees representing 625 species and varieties. Hofstra is less than an hour away from New York City making it an easy commute for any students with internships in Brooklyn or Manhattan. Known for its small classes, with an average class size of 21 students, Hofstra offers 100 percent accessibility to students with disabilities. The university offers both bachelor and master levels of degrees in Sustainability (Hofstra 2018a, c, 2017b, d). According to a website of student opinions, students stated that Hofstra University's uniqueness was due to its diversity and location to New York City (UNIGO 2017). What really makes Hofstra stand out from other universities is that it is the only university to host three consecutive US presidential debates (2008, 2012, and 2016) with the technical support provided by their IT Department (Hofstra 2017e). Sustainability is practiced throughout the campus. Some examples are:

- The School of Medicine building, Leadership in Energy and Environmental Design (LEED) certified
- EV stations
- Water bottle stations
- Co-gen plant
- Annual community food donations for people experiencing food insecurity (Hofstra 2017f, i, 2018g, h)

Historically, Hofstra's main IT focus is cost savings and efficiency. Rather than recycling laptops and desktops they had previously leased, they implemented a plan to reuse them. By choosing to refunction, rather than recycle, Hofstra reduced carbon emissions and costs over an expected six-to-eight-year

life span of the IT products. To date, Hofstra's IT Department has repurposed to VDI approximately 236 laptops for student use. Hofstra has seven production VDI classrooms with laptops and one with desktop computers. By repurposing their laptops, Hofstra is reducing landfill and diminishing the amount of CO_2 entering the atmosphere from the manufacturing process of new laptops.

Hofstra has four data centers. One is on an off-site location in Syracuse and is a disaster recovery center. The second center is the business continuity data center which has programs that can be accessed by faculty, administrators, staff, and students. The third, the Big Data Lab, is discussed later in this case study. The fourth, the Main Computer Room, is located on-site. The Main Computer Room provides the support for the virtual desktop infrastructure run from Hewlett Packard (HP) servers. Hofstra is continuing to move from physical servers to virtual servers and as the need arises the virtual servers are added to the data centers. The Main Computer Room is an example of Green IT. It has 250 servers, 25 of which are hypervisors. These 25 hypervisors can accommodate approximately 400 VDI users. The CPU is a 2 × 14 Xeon Processor. The system architecture is the x86_64. While the sustainability of VDIs and hypervisors was discussed previously, Hofstra's choice of processor and systems architecture adds to the sustainability by supporting and enhancing the hypervisor's functionality. The HVAC is set up in an older format with the data center's raised floors providing the avenue for circulating cooler air.

Hofstra uses a high-performance database storage server called a ZFS to operate their technology. The ZFS operates a hybrid disk array that combines high-speed RAM, SSD, and traditional spinning hard drive in a cost-effective way to obtain the speed and ruggedness of an expensive 100 percent SSD. For the VDI, the ZFS will move the Windows 7 or Windows 10 boot into RAM which reduces login time for the user. It is also a more sustainable solution since SSDs use flash memory, a form of transistor, like those found in a USB (Hruska 2016). Standard hard drives use magnets made with neodymium, a rare earth element.

Hofstra University uses AWS. In 2009, Hofstra contracted Amazon's web services to upgrade their computer architecture with cloud IaaS in preparation for the 2012 presidential debate held at the university. Had Hofstra not switched to AWS in 2009, they would have found it imperative to purchase an additional 12 servers. By utilizing Amazon's servers, Hofstra achieved cost and environmental savings. AWS also provides flexibility and additional cost savings during the university's enrollment period. Their web architecture allows for scalability with a pay as you go payment structure. Scalability provides an environmental function. By not having to purchase additional servers

that might be used rarely or not at all, the university has potentially reduced air pollutants from factories and the supply chain and environmental waste from mining.

Hofstra's Big Data Lab is located in a separate building on campus and primarily services the School of Engineering and Applied Science. The Big Data Lab was installed in 2014 in the lower level of the building even though data centers are normally placed on higher floors to protect against water damage from storm water overrun or floods; constraints due to the age of the building made it economically necessary to place it in the basement. To support a second-floor data center would have required a structure of reinforced steel beams. With the data center restricted to the basement, it was not possible to build a floor for the HVAC to flow through. Instead a more sustainable approach was taken. Hofstra's Big Data Lab uses thick plastic strips called Air Curtains, placed around the server racks to form two chambers. The cold air fills the space in front, which enters the servers and exits the back of the racks as hot air into a rear area. This flow-through ventilating process reduces the energy required to cool the room. The industry term is precision cooling. It keeps the cool air on the servers' hardware while keeping the heat pushed to the back of the room where it has no effect on the IT equipment. Due to its modern design, Hofstra's Big Data Lab has accomplished a PUE of 1.33. With 1.88 an average PUE, Hofstra's results are excellent. Its HVAC system uses the refrigerant R410A which contains fluoride, a chemical which does not deplete the ozone. The Big Data Lab has 21 physical IBM system x3650 M4 BD servers that run hundreds of virtual machines.

By using virtual servers rather than physical servers, power and cooling requirements are reduced. According to IBM (2012):

> *The IBM System x3650 M4 contains several technologies that further reduce the power requirements per server. These include the Intel Turbo Boost Technology 2.0 – More intelligent power management allows for increased power efficiency. An eXFlash – Reduces the power required by 99 percent compared with spinning disks and More efficient power supplies – Ultra efficient power supplies, rated up to 80 plus Platinum, make much better use of the power that servers consume.*

The Raid 6 hard drive allows for redundancy and protects against disk failure and unrecoverable errors. The CPUs are 2 × 8 core Xeon, which are microprocessors based on the x86_64 architecture. The CPU VMware ESXi 5.5 Hypervisor controls the 21-server cluster environment and creates virtual machines (VMs). If this particular CPU was not used, the university would be purchasing laptops for the students, and hypervisors would need to be installed

on the student's laptops for them to access the VM. This would be an increase in monetary and environmental costs and result in a loss of energy efficiency with an increase in power usage. VMs have separate CPUs from each other and from the host CPU and possibly different instruction architecture.

Hofstra recycles their laptops through Sycamore International. This company's main business drive is to keep electronics out of landfill (Sycamore International 2017). With Sycamore refurbishing as many computers as possible, Hofstra has reduced landfill and given an audience with limited financial means digital access through owning a refurbished laptop (Fosdick 2012). Refurbishing a laptop or manually removing the neodymium magnet reduces the damaging environmental impact created either by mining neodymium or placing it in landfill. Recycling and refurbishing can curtail the increase in global warming (Lakhan 2016). Hofstra's ongoing project to increase their VDI along with recycling with their current partner will contribute to diminishing global warming.

In addition to all the environmental savings, Hofstra University has increased their technology efficiency and reduced their costs substantially. Over a nine-year period, the university has saved an estimated two million dollars with the savings distributed as shown in Table 33.1.

By increasing their virtual servers from 28 to 270, Hofstra reduced the need for various ports and server racks. The actual component savings over the nine-year period is 810 network ports, 270 KVM ports, 540 PDU ports, and 14 server racks.

This decrease in the need for physical equipment increases environmental savings. It reduces environmental costs associated with mining rare earth elements, factory-produced GHGs from burning fossil fuels, and the need to burn fuel for cargo transportation. When planning to improve technology, whether approached from an environmental standpoint or an efficiency one with a cost reduction requirement, all approaches arrive at the same conclusion. Efficiency is improved, cost savings are achieved, and the environment wins.

Table 33.1 Hofstra's hardware Reductions

61 percent	Hardware costs
8 percent	Maintenance costs
11 percent	Electrical products
12 percent	Network ports
3 percent	Keyboard, video, mouse ports
1 percent	PDU (power distribution unit) ports
4 percent	Floor rack space

This case study has opened a door to the IT Department's perception of sustainability. They are now cognizant that sustainable processes and cost savings proposals will yield the same results. This knowledge will expand their decisions when reviewing new technology products.

Lessons Learned

- "Green computing, Green Information and Communication Technology (ICT), as per the International Federation of Green ICT (IFGICT) and IFG Standard, Green IT, or ICT sustainability, is the study and practice of environmentally sustainable computing or IT" (The *Journal of Scientific and Engineering* 2015, 1513). San Murugesan (2008, 25) provides a more explicit definition stating, "It's the study and practice of designing, manufacturing, using, and disposing of computers, servers, and associated subsystems-such as monitors, printers, storage devices, and networking and communications systems — efficiently and effectively with minimal or no effect on the environment." As the environment continues to be impacted by global warming (Lewin 2017), IT products and processes that are environmentally sustainable—green—can also add efficiency and cost savings to an organization's bottom line.
- Green IT counteracts all the negative environmental impacts described in this chapter. When virtual desktop infrastructure and virtual servers are utilized in place of stand-alone desktop infrastructures or servers, there are immeasurable environmental benefits. The need for manufactured computer hardware units is lessened, thereby reducing the amount of energy required to produce them. Reducing energy generated from fossil fuels would diminish land devastation and decrease greenhouse gas emissions. A positive snowball effect is established. Sustainable—green—technology interfaces with efficiency and effectiveness, in the streamlining of both processes manufacturing and transportation.
- This streamlining also brings a financial benefit to Green IT Departments. Less energy consumption in data centers and classrooms reduces costs. Other green efficiency-focused cost savings are garnered by moving to a virtual infrastructure (Beckett 2017; Mithas et al. 2010, 7). This chapter documents the savings that Hofstra has achieved with green changes. In addition to the actual dollar savings, as per the Hofstra technicians, imaging a VDI reduces hands-on time by several hours, allowing for greater performance from the staff, which benefits the bottom line.

- VDI provides students with more space at their station and offers a greater contemporary visual presentation. There is also less heat generated adding to a more comfortable setting with an increased level of air quality due to reduction of emissions from individual CPUs. Green IT adds to a universities' global recognition of their commitment to sustainability (Georgia Northwestern Technical College 2017).
- Hofstra University's IT Department learned that reducing costs and increasing efficiency promoted sustainability.

Challenges and Barriers

- IT managers whether in businesses or universities are cost conscious and may not realize that, as this chapter demonstrates, Green IT supports cost savings.
- Securing legislation that requires laptop and server hardware manufacturers to recycle their products is difficult due to requiring a firm committment and agreement from lawmakers, manufacturers and users.
- Ensuring environmental protection to mining areas and sustainable living conditions for the miners of the rare earth elements used in technology products such as hard drives will involve international collaboration.
- To promote and encourage technology supply chains to support and practice sustainability.
- Assigning a life assessment label to Green IT products to include different environmental impacts such as GHGs emitted during manufacturing, amount of water filtration, waste disposal, and source of rare earth elements.
- Ineffective and inaccurate marketing of Green IT products creates confusion and distrust.
- Older buildings may not have the network connectivity or proper building infrastructure to handle the ever-changing technology growth. As mentioned in this case study, Hofstra's Big Data Lab could not be located on a higher floor due to building constraints.
- International regulations lack a regulatory policing section. Compliance with global environmental policies is non-compulsory.

Acknowledgments Thank you to the Hofstra IT staff for their hard work and support for this chapter.

Robert W. Juckiewicz: Vice President for IT

Antonio Leo: Director of Systems and Operations

Toon-Chien Wong: Associate Technical Director of Systems and Operations
Joshua Daubert: Systems Project Mgr. and Mgr. of Data Center Operations
Luc-Philippe Paulemon: Instructional Technologist
Alexander Rosenberg: Computer Science Systems Administrator

References

Amazon Web Services (AWS) – Cloud Computing Services. 2017. Amazon Web Services. Inc. https://aws.amazon.com/.

An Overview of VirtualBox 2. 2008. *An Overview of VirtualBox 2 – Virtuatopia*. March 4. http://www.virtuatopia.com/index.php/An_Overview_of_VirtualBox_2. Accessed 1 Oct 2017.

Barrass Hugh, Christian Berard, Stephen Berard, Mark Bramfitt, Tahir Cader, Henry Coles, Jud Cooley, Tommy Darby, Jamie Froedge Emerson, Nick Gruendler, Jon Haas, Eric Jewitt, Christine Long, Bob MacArthur, Phil Morris, Zeydy Ortiz, John Pflueger, Andy Rawson, Jim Simonelli, Harkeeret Singh, Roger Tipley, Robert Tozer, Gary Verdun, John Wallerich, and Randall Wofford. 2012. *PUE™: A Comprehensive Examination of the Metric*. The Green Grid. https://www.thegreengrid.org/.

Beckett, Helen. 2017. How Green IT Delivers Big Energy Savings. *ComputerWeekly.Com*. http://www.computerweekly.com/feature/How-green-IT-delivers-big-energy-savings.

Carlowicz, Michael. 2010. World of Change: Global Temperatures: Feature Articles. *Earth Observatory*, December 9. http://earthobservatory.nasa.gov/Features/WorldOfChange/decadaltemp.php.

Chrobak, Pawel. 2014. Implementation of Virtual Desktop Infrastructure in Academic Laboratories. In, 1139–1146. doi:https://doi.org/10.15439/2014F213.

Cooney, Michael. 2011. *Computer Factories Eat Way More Energy than Running the Devices They Build Network World.* IDG Communications, Inc. April 14. http://www.networkworld.com/article/2229029/data-center/computer-factories-eat-way-more-energy-than-running-the-devices-they-build.html.

Corazon Aureus, Mia. 2014. Rise in China's Coal-fired Capacity in 2014, 2015 May Not Boost Thermal Coal Prices: UBS – Coal. *Platts News Article & Story*, May 4. http://www.platts.com/latest-news/coal/singapore/rise-in-chinas-coal-fired-capacity-in-2014-2015-21573872.

Cowley, Stacy, Tara Siegel-Bernard, and Danny Hakim. 2017. Equifax Breach Prompts Scrutiny, but New Rules May Not Follow – The New York Times. *The New York Times*, September 15. https://www.nytimes.com/2017/09/15/business/equifax-data-breach-regulation.html?mcubz=1&module=ArrowsNav&contentCollection=Business%20Day&action=keypress&region=FixedLeft&pgtype=article.

Daitch, Heidi. 2017. 2017 Data Breaches – The Worst Breaches, So Far | IdentityForce®. *Identity Force*, September 22. https://www.identityforce.com/blog/2017-data-breaches.

Dean, Jason, and Pui Wing Tam. 2005. The Laptop Trail the Modern PC Is a Model of Hyper Efficient Production and Geopolitical Sensitivities. *The Laptop Trail*, June 9. https://www.wsj.com/articles/SB111825761813954442.

Erol-Kantarci, Melike, and Hussein T. Mouftah. 2015. Energy-Efficient Information and Communication Infrastructures in the Smart Grid: A Survey on Interactions and Open Issues. *IEEE Communications Surveys & Tutorials* 17 (1): 179–197.

European Commission Takes Leap to Boost Cloud Computing. 2013. *EU Reporter*. https://www.eureporter.co/frontpage/2013/10/28/european-commission-takes-leap-to-boost-cloud-computing/. Accessed 24 Sept 2017.

Fosdick, H. 2012. Computer Refurbishing: Environmentally Reducing the Digital Divide. *Bulletin of the American Society for Information Science and Technology* 38: 58–62. https://doi.org/10.1002/bult.2012.1720380314.

Gabriel, Chris. 2008. Why It's Not Naive to Be Green. *Business Information Review* 25 (4). https://doi.org/10.1177/0266382108098865.

Green Computing. 2015. *International Journal of Scientific & Engineering Research* 6(9) (September 2015): 1513–1535.

Global and China Laptop and Tablet PC Industry Report, 2011–2012. 2012. *PR Newswire: Press Release Distribution, Targeting, Monitoring and Marketing*, May 22. http://www.prnewswire.com/news-releases/global-and-china-laptop-and-tablet-pc-industry-report-2011-2012-152524185.html.

Graham, Karen. 2015. Baotou – A Toxic Lake Created because of a Thirst for Technology. *Digital Journal*, April 11. http://www.digitaljournal.com/news/environment/baotou-a-toxic-lake-created-because-of-a-thirst-for-technology/article/430511.

Griffith, Eric. 2016. What Is Cloud Computing? | PCMag.Com. *PCMag*, May 3. https://www.pcmag.com/article2/0,2817,2372163,00.asp.

Hamm, Michele P., Amanda S. Newton, Annabritt Chisholm, Jocelyn Shulhan, Andrea Milne, Purnima Sundar, Heather Ennis, Shannon D. Scott, and Lisa Hartling. 2015. Prevalence and Effect of Cyberbullying on Children and Young People: A Scoping Review of Social Media Studies. *JAMA Pediatrics* 169 (8): 770–777. https://doi.org/10.1001/jamapediatrics.2015.0944.

Hill, Gerald, and Kathleen Hill. 2017. Legal Dictionary – Law.Com. *Law.Com Legal Dictionary*. http://dictionary.law.com/Default.aspx?selected=2083. Accessed 3 Oct 2017.

Hofstra University, New York. 2017b. *Grounds & Arboretum*. http://www.hofstra.edu/about/campus/facops/facops-grounds-arboretum.html. Accessed 17 Sept 2017.

———. 2017d. *Sustainability Studies*. http://www.hofstra.edu/academics/colleges/hclas/geol/sbly/index.html. Accessed 21 Sept 2017.

———. 2017e. *Debate 2016*. http://www.hofstra.edu/debate. Accessed 21 Sept 2017.

———. 2017f. *Hofstra North Shore-LIJ School of Medicine Opens New Building, Earns Full National Accreditation*. Hofstra Northwell School of Medicine at

Hofstra University. http://medicine.hofstra.edu/about/news/news-new-building.html. Accessed 25 Sept 2017.
———. 2017i. *Sustainability at Hofstra University*. http://www.hofstra.edu/about/campus/facops/environ/index.html. Accessed 17 Sept 2017.
———. 2018a. *About Hofstra*. Hofstra at a Glance. New York. http://www.hofstra.edu/about/about_glance.html Accessed 2 Feb 2018.
——— 2018c. Admission. Student Profile. https://www.hofstra.edu/admission/adm_stdprofile.html. Accessed 2 Feb 2018.
———. 2018g. Office of Sustainability. Environment. https://www.hofstra.edu/about/campus/facops/environ/environ_services.html. Accessed 2 Feb 2018.
———. 2018h. Office of Sustainability. Environment. https://www.hofstra.edu/about/campus/facops/environ/environ_cogen.html. Accessed 2 Feb 2018.
Home. 2017. *Sycamore International*. http://www.sycamoreinternational.com. Accessed 20 Dec 2016.
Horton, Julia. 2012. *Greenhouse Gases Rise by 260% Since Industrial Revolution – The Scotsman*. November 20. http://www.scotsman.com/news/environment/greenhouse-gases-rise-by-260-since-industrial-revolution-1-2646644.
Hruska, Joel. 2016. How Do SSDs Work? *ExtremeTech*, February 26. https://www.extremetech.com/extreme/210492-extremetech-explains-how-do-ssds-work.
Iannucci, Lisa. 2006. *New York City's Recycling Programs – Where Does the Garbage Go?* https://cooperator.com/article/where-does-the-garbage-go.
IBM – What Is Cloud Computing? 2016. October 17. https://www.ibm.com/cloud-computing/learn-more/what-is-cloud-computing/.
Information Technology. 2017. Merriam-Webster.com. https://www.merriam-webster.com/dictionary/InformationTechnology. Accessed 17 Sept 2017.
Ives, Mike. 2017. Boom in Mining Rare Earths Poses Mounting Toxic Risks. *Yale E360*. http://e360.yale.edu/features/boom_in_mining_rare_earths_poses_mounting_toxic_risks. Accessed 28 Jan 2017.
Kelly, Heather. 2013. The Power of One Wrong Tweet – CNN. *CNN*, April 24. http://www.cnn.com/2013/04/23/tech/social-media/tweet-ripple-effect/index.html.
Kleyman, Bill. 2012. Hypervisor 101: Understanding the Virtualization Market. *Data Center Knowledge*. August 1. http://www.datacenterknowledge.com/archives/2012/08/01/hypervisor-101-a-look-hypervisor-market.
Lakhan, Calvin. 2016. Calculating the Emissions Impacts of Waste Electronics Recycling in Ontario, Canada. *C* 2 (2): 11. doi:https://doi.org/10.3390/c2020011. Accessed 1 Apr 2017.
Lewin, Sarah. 2017. Heat Record: How NASA Knows 2016 Was the Hottest Year. *Live Science*, January 19. http://www.livescience.com/57555-how-nasa-knows-2016-was-hottest-year.html.
Lifton, Jack. 2011. *The Issue of Residual Thorium & Uranium From Rare-Earth Ore Processing – Technology Metals Research*. TMR Technology Metals Research. March 11. http://www.techmetalsresearch.com/2011/03/the-issue-of-residual-thorium-uranium-from-rare-earth-ore-processing/.

Mithas, Sunil, K. Prasanto Roy, and Jiban Khuntia. 2010. Green IT, Energy Efficiency, and Profits: Evidence from an Emerging Economy. In *ICIS 2010 Proceedings*, 11. http://aisel.aisnet.org/icis2010_submissions/11.

Murugesan, San. 2008. Harnessing Green IT: Principles and Practices. *IT Professional* 10 (1): 24–33.

NYC Department of Sanitation. 2015. *DSNY – About – Recycling Laws for Residents*. http://www1.nyc.gov/assets/dsny/about/laws/recycling-laws-for-residents.shtml.

NYC Electronics Drop Off Locations. 2015. *NYC Department of Sanitation*. April 1. http://www1.nyc.gov/assets/dsny/zerowaste/residents/electronics.shtml.

NYC Sanitation. 2017. *New Business Recycling Rules*. https://www1.nyc.gov/assets/dsny/docs/commercial-recycling-notice-english.pdf. Accessed 23 Sep 2017.

Office of Energy Efficiency & Renewable Energy. *Energy-Efficient Cooling Control Systems for Data Centers | Department of Energy*. https://energy.gov/eere/amo/energy-efficient-cooling-control-systems-data-centers. Accessed 20 Dec 2016.

Recycling Consumer Electronic Waste – NYS Dept. of Environmental Conservation. 2015. *NYS Department of Environmental Conservation*. January 1. http://www.dec.ny.gov/chemical/66872.html.

Rodrigue, Jean-Paul. 2017. *The Environmental Impacts of Transportation*. The Geography of Transport Systems. https://people.hofstra.edu/geotrans/eng/ch8en/conc8en/ch8c1en.html. Accessed 23 Sept 2017.

Rost, Katja, Lea Stahel, and Bruno S. Frey. 2016. Digital Social Norm Enforcement: Online Firestorms in Social Media. *PLoS ONE* 11 (6). https://doi.org/10.1371/journal.pone.0155923.

Rouse, Margaret. 2014. What Is BIOS (Basic Input/Output System)? Definition from WhatIs.Com. *Whatis.Com*, August. http://whatis.techtarget.com/definition/BIOS-basic-input-output-system.

———. 2016a. What Is Operating System (OS)? Definition from WhatIs.Com. *WhatIs.Com*, September 2016. http://whatis.techtarget.com/definition/operating-system-OS.

———. 2016b. What Is RAM (Random Access Memory)? Definition from WhatIs.Com. *SearchStorage*, September. http://searchstorage.techtarget.com/definition/RAM-random-access-memory. Accessed 17 Sept 2017.

Schiavenza, Matt. 2013. China's Dominance in Manufacturing – in One Chart – The Atlantic. *The Atlantic*, August 5. https://www.theatlantic.com/china/archive/2013/08/chinas-dominance-in-manufacturing-in-one-chart/278366/.

Schlossberg, Tatiana. 2016. Just How Much Power Do Your Electronics Use When They Are 'Off'? *The New York Times*, May 7. http://www.nytimes.com/2016/05/08/science/just-how-much-power-do-your-electronics-use-when-they-are-off.html.

Shane, Scott. 2017. Mystery of Russian Fake on Facebook Solved, by a Brazilian. *The New York Times*, September 13. https://www.nytimes.com/2017/09/13/us/politics/russia-facebook-election.html.

Student VDI Georgia Northwestern Technical College. 2017. http://www.gntc.edu/email/student-vdi/.

The New IBM System x M4 servers A Microsoft Exchange. 2012. IBM Systems and Technology Group, March.

Toxins Found in E-Waste Urbanmining. 2015. *Urban Mining*, January 5. http://urbanmining.org/2015/01/toxins-found-ewaste.

UNFC. 2014. *Kyoto Protocol*. United Nations Framework Convention on Climate Change. http://unfccc.int/kyoto_protocol/items/3145.php.

US EPA, OAR. 2015. International Actions – The Montreal Protocol on Substances That Deplete the Ozone Layer. Reports and Assessments. *US EPA*, July 31. https://www.epa.gov/ozone-layer-protection/international-actions-montreal-protocol-substances-deplete-ozone-layer.

———. U.S. Greenhouse Gas Inventory Report: 1990-2014. https://www.epa.gov/ghgemissions/us-greenhouse-gas-inventory-report-1990-2014.

Vladimirskiy, Vadim. 2016. 10 Popular Software as a Service (SaaS) Examples – MSP Blog. *Nerdio*, October 20. http://getnerdio.com/blogs/10-popular-software-service-examples/.

Wein, Rebecca. 2017. *What Is Virtual Desktop Infrastructure VDI? Parallels Answers*. Parallels Remote Application Server Blog – Application Virtualization, Mobility and VDI. March 30. http://www.parallels.com/blogs/ras/virtual-desktop-infrastructure-vdi/.

What's Unique about Your Campus? Hofstra University Unigo. 2017. *UNIGO*. https://www.unigo.com/colleges/hofstra-university/q-and-a/whats-unique-about-your-campus-25/2.

Williams, Eric. 2004. Energy Intensity of Computer Manufacturing: Hybrid Assessment Combining Process and Economic Input-Output Methods. *Environmental Science & Technology* 38 (22): 6166–6174. Academic Search Complete, EBSCOhost (Accessed 1 Feb 2018).

World Commission on Environment and Development. 1987. http://www.un-documents.net/our-common-future.pdf. Accessed 3 Oct 2017.

Zhou, Kaile, Shanlin Yang, Chao Shen, Shuai Ding, and Chaoping Sun. 2015. Energy Conservation and Emission Reduction of China's Electric Power Industry. *Renewable and Sustainable Reviews Science Direct*, May. http://www.sciencedirect.com.ezproxy.hofstra.edu/science/article/pii/S1364032115000660.

Part IV

Regional and Local Examples

This group of chapters contains several examples that look at sustainability holistically. It includes local and regional examples from several places around the world where there are distinct sustainability challenges. The section outlines examples from Southeast Asia, where air pollution is a particularly vexing problem; from North America where Canada has proven itself to be a leader in national sustainability planning; and from Luxembourg where the challenge of managing sustainability in a small state is addressed.

Collectively, the group represents how sustainability can be studied and managed at different scales. They highlight that regardless of the size of a place, there are distinct ways that we can measure, assess, and address sustainability problems. The group of chapters provides many real-world examples where sustainability initiatives have proven successful and others where sustainability remains an elusive target.

34

Sustainability in North America: The Canadian Experience

Mark Roseland and Maria Spiliotopoulou

Background

Sustainability in the Global Context

A growing number of scholars refer to the modern period as the Anthropocene, the era when human population and economic growth are unfolding at a pace that is detrimental for our host planet. The fact that we live in a finite world is widely recognized and current generations now have both the knowledge and the responsibility to lead humanity toward a more sustainable future.

Sustainable development (SD) became popularized in 1987 when the Brundtland Commission report showed that 26 percent of the world's population living in developed countries consumed 80–86 percent of non-renewable resources and 34–53 percent of food products (WCED 1987). Although the concept has been criticized as ambiguous and open to contradictory interpretations, there are some common characteristics in most definitions: balance in integrating environmental, economic, and social aspects; significance of systems thinking for both local and global scales; and recognition of the dynamic and ever-evolving nature of SD (Berke and Conroy 2000). SD[1] involves a new way of thinking about economic development over the long term: it is about "doing development differently" (Roseland 2012).

M. Roseland (✉) • M. Spiliotopoulou
School of Resource & Environmental Management, Simon Fraser University, Burnaby, BC, Canada

R. Brinkmann, S. J. Garren (eds.), *The Palgrave Handbook of Sustainability*,
https://doi.org/10.1007/978-3-319-71389-2_34

Ecological modernization, a term which was coined in the 1980s as a response to the environmental degradation apparently due to the relentless pursuit of economic growth, is a key concept of various environmental and SD initiatives in North America and worldwide over the past three decades. Through improvements in technology and design, energy and resource efficiency, and innovations in production, ecological modernization primarily seeks to achieve congruence between the economic and the ecological dimensions of sustainability: providing sound solutions to environmental problems created by human activity while contributing to further growth through a cleaner economy which internalizes the environmental risks (Bayulken and Huisingh 2015).

Although today in most SD plans and initiatives the environmental, economic, and social dimensions are prominent, this hasn't always been the case; the environmental and economic aspects of sustainability were more visible than the social aspect until more recently. Eminent science and policy figures such as Robert Putnam started drawing attention to the importance of social capital (i.e. social responsibility, trust, networks, shared knowledge, social structures and relations, and norms) in the 1990s. Some researchers consider that sustainability is an advancement of the 1980s environmental justice movement which converged social and environmental activism, advocating the right to a clean and safe environment for all (Agyeman 2013; Salcido 2016). Social sustainability then became stronger as researchers and citizen movements demanded the inclusion of social concerns, such as inter- and intra-generational equity, into any sustainability discussion. There has been a gradual shift from a weak sustainability view that seeks the reduction of environmental impact through efficiencies to a strong sustainability view that advocates for the preservation and even enhancement of natural resources for the sake of current and future generations.

At the time Agenda 21, a sustainable development action plan for the twenty-first century, was adopted at the UN Conference on Environment and Development in Rio in 1992, we were witnessing the dawn of more mainstream public awareness about environmental issues. By the World Summit on Sustainable Development in 2002, there was an increasing sense of crisis, as knowledge about the state of environmental systems showed a continued negative trend and need for urgent action. A new era for SD globally was marked by the achievement of notable decreases in poverty, mortality, and disease rates in the developing world, following the adoption of the UN Millennium Development Goals in 2000.

At the Rio+20 Earth Summit in 2012, the post-2015 UN Development Agenda was initiated and, in 2015, 193 countries adopted the new UN

Development Agenda in the form of the Sustainable Development Goals (SDGs): 17 goals and 169 concrete targets and indicators aiming to tackle poverty, climate change, and inequality in both developed and developing nations. This agenda is grounded in a holistic view of sustainability which was also acknowledged in the UN Framework Convention on Climate Change agreement in 2015 to keep the global average temperature "well below 2°C above pre-industrial levels and to pursue efforts to limit the temperature increase to 1.5°C above pre-industrial levels" (United Nations 2015).

Sustainability in North America

With approximately 5 percent of the global population and 11 percent longer life expectancy than the global average, North America, here meaning the United States and Canada, today produces 18 percent of global GDP, and accounts for 12 percent of global goods and services exports and 15 percent of global goods and services imports. At the same time, North America is responsible for 28 percent of the global energy use (kg of oil equivalent per capita) and emits three times more than the total global CO_2 per capita emissions. North Americans, along with Europeans, Japanese, and Australians, may be only about 20 percent of global population, but they consume more than 80 percent of global resources and account for more than 60 percent of private consumption spending worldwide (World Bank Open Data; Worldwatch Institute; David Suzuki Foundation). Such trends have not been without consequences, globally but also regionally and locally, and have thus led to the unfolding of movements for environmental protection, environmental and social justice, and more recently sustainable development.

Sustainability in North America, particularly in the United States, emerged as a result of significant concerns about the social and environmental consequences of rapid growth of population and the economy as well as the constantly increasing consumption of natural resources since the nineteenth century. Conservation and preservation movements started establishing and taking action early in the twentieth century as leading scientists argued that the North American environment was deteriorating, notably due to native forest destruction and species extinction. These movements contributed to the adoption of conservation legislation in the United States, where, with the support of Theodore Roosevelt, many conservation areas and wildlife reserves were created or expanded.

At the end of the Second World War, North American and Western European countries decided to focus almost entirely on their economic development,

aiming to increase standard of living, freedom, human rights, and economic opportunities. This focus on economic growth and the reduction of its impact on the environment, which was only considered as an externality, demonstrates the anthropocentric—or weak sustainability—viewpoint implicitly taken then by North American and other Western administrations and industrialists.

Achievements such as higher living standards, infrastructure creation and expansion, and urban sprawl came at a cost: the United States experienced incidents of chemical pollution in waterways or the ocean (e.g. oil spill off California's coast in 1969), serious human health problems and deaths (e.g. thousands of victims of industrial air pollution in Pennsylvania in 1948, the siting of hazardous wastes and polluting industries near residences of people of color famously symbolized by Love Canal[2]), and at the same time the growing public awareness of the impacts of pollutants and resource exploitation not only on the environment but also on humans in their pursuit for improved quality of life and social freedoms and equity; Rachel Carson's *Silent Spring* was published in 1962 and is indicative of this increasing sense of environmental crisis.

These historical milestones brought about the establishment of the US Environmental Protection Agency, a series of laws and policies, as well as the US environmental justice movement (NRC 2011; Agyeman 2013). The National Environmental Policy Act (NEPA) was signed in 1969 by President Nixon and involved wording that pertained to sustainability principles which were not global yet at that time: the existence of humans and the natural environment in harmony while attending to social and economic needs of current and future generations.

The Nixon administration also created the US Environmental Protection Agency in 1970, as the main federal agency responsible for the protection of human health and the environment in the United States, through legislation such as the Clean Air Act, the Clean Water Act, the Safe Drinking Water Act, and the Comprehensive Environmental Response, Compensation, and Liability Act (NRC 2011). Other federal agencies with environmental responsibilities are the Departments of Interior, Transportation, and Energy, while individual state-level and local agencies have the power to adopt and implement their own—often stricter—environmental and sustainability policies. The mandate conferred to EPA through NEPA also included the requirement for federal agencies to consider the environmental impact of their projects and incorporate related steps in their decision-making processes.

Over these past few decades, US environmental and conservation laws and policies have included principles and objectives that relate to the three

dimensions of sustainability, directly or indirectly: protection of human health, preservation of ecological areas presenting use value (recreation, harvesting) and non-use (existence) value, establishment of environmental justice and inter-generational equity, pursuit of efficiency, and advancement of technology and scientific knowledge. The United States also has a long cooperation with the Organisation for Economic Co-operation and Development (OECD), the United Nations Environment Programme (UNEP), the World Health Organization (WHO), and other significant international fora, as well as the recent ratification of the Paris Climate Change Agreement which entered into force in November 2016.

Despite such advancements, however, the United States has so far demonstrated little willingness to adopt agreements meant to mitigate human impact on the Earth by reducing consumption of resources. The United States—which Canada has often joined in the past—withdrew from, didn't ratify, or didn't sign several global environmental agreements, including the Kyoto Protocol, the Convention on Biological Diversity, the UN Law of the Sea Convention, and the Basel Convention on the control of transboundary movements of hazardous wastes and their disposal.

On the positive side, North America has made important steps toward environmental protection and sustainable development through the North American Free Trade Agreement (NAFTA) and its Commission for Environmental Cooperation (CEC). NAFTA entered into force in 1994 with the aim of generating economic growth for its Member States—the United States, Canada, and Mexico—and increasing quality of life through common rules for trade and investment across the three countries' borders.

NAFTA was the first free trade agreement to set objectives that related to the environmental impact of trade; its preamble includes goals such as the protection and conservation of the environment, the promotion of sustainable development, and strengthening related enforcement measures, and other NAFTA articles ask that environmental concerns are taken into account in trade and investment. Even though environmental considerations have not always been at the center of decision-making within the NAFTA area, some achievements worth mentioning include the reduction in Mexico City's pollution, the creation of La Secretaria de Desarrollo Social (SEDESOL), a decrease in industrial polluters and related disputes and litigations, the growth of environmental, community-based—and often transnational—organizations, and the establishment of the Commission for Environmental Cooperation.

The CEC was partly established as a response to voices raised by environmental and other community groups and labor unions with regard to the absence of environmental and social sustainability components in NAFTA. The Clinton administration advocated for a "NAFTA-plus" agenda, which included two new agreements—the North American Agreement on Labor Cooperation (NAALC) and the North American Agreement of Environmental Cooperation (NAAEC); they both came into effect in 1994. Based on NAAEC, the North American Commission for Environmental Cooperation, a trinational agency, was created and headquartered in Montreal, Quebec.

According to its first article, NAAEC promotes sustainable development based on cooperation and mutually supportive environmental and economic policies. It recognizes the interconnections between a sustainable environment and a sustainable economy and fosters both, an objective which is also evident in the Commission's strategic plans of 2005–2010 and 2010–2015 that explicitly focus on environmental and economic sustainability. Through environmental collaboration at the government and at the citizen and community levels, CEC seeks to address any related concerns that emerge from increasing free trade between the three countries. Social development and public engagement are embedded in CEC's operations from the very beginning: the Joint Public Advisory Committee comprises 15 representatives, five from each country, from the business and academic sectors, non-governmental organizations, and citizens, and ensures active stakeholder participation and transparency.

All sustainability dimensions are now explicitly mentioned in CEC's current strategic plan that promotes the integration of environmental with economic and social development, the inclusion of traditional ecological knowledge, and the development of partnerships and a shared responsibility among stakeholders. This Commission offers a significant opportunity for North America; the governments of Canada, Mexico, and the United States can work together with civil society to pursue what none of these countries could achieve on its own.

This section described the sustainability experience in North America and particularly the historical milestones in the United States with respect to sustainable development. Canada's history and experience has—in some ways and in some points in time—followed the United States and in other ways has diverged significantly; this is the focus of the next section as it will detail the Canadian case study in sustainable development.

Case Study: Sustainability in Canada

Introduction: Canada's Environment

Canada is considered one of the best places in the world in terms of quality of life and natural resource abundance. The country has a wealth of natural resources and vast areas of still pristine environment; Canada has 20 ecozones—15 terrestrial and five marine—which are linked to the ecological regions of North America and the global ecological zones of the UN Food and Agriculture Organization (Fig. 34.1). Wetlands, considered one of the most productive types of ecosystem, cover about 13 percent of Canada's terrestrial area and account for about 25 percent of the world's wetlands. Canadian forests cover an area of 347 million hectares, that is, about nine percent of the

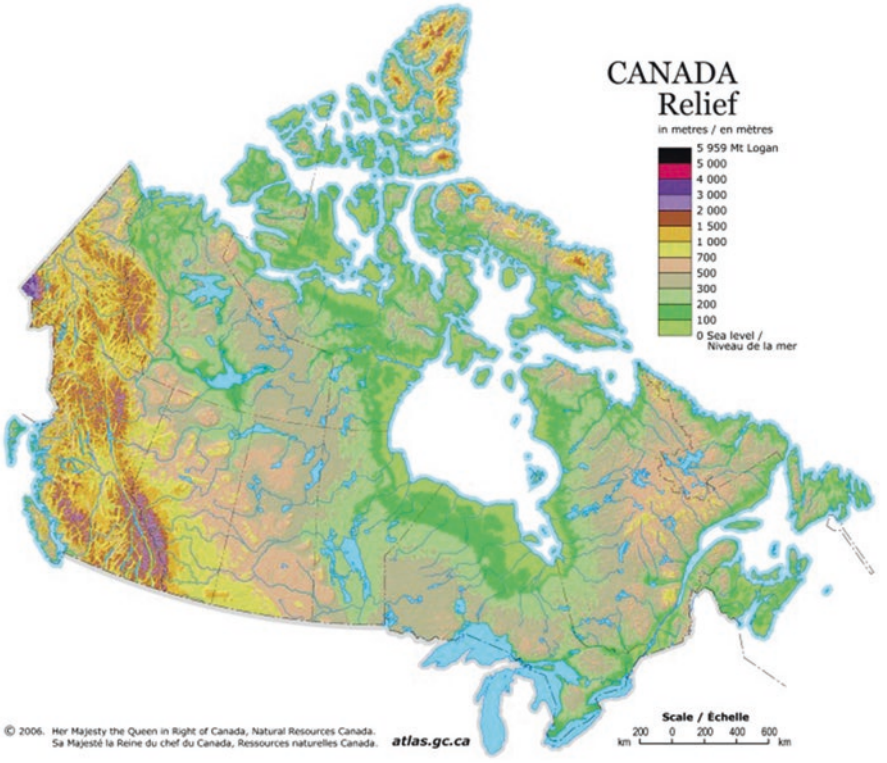


Fig. 34.1 A topographic map of Canada. Created on April 14, 2006, by Anchjo, available at https://commons.wikimedia.org/wiki/Atlas_of_Canada#/media/File:Canada_topo.jpg, and used here under CC BY-SA 3.0, with a modification: converted to black and white (The topographic map is the fifth map under General Maps.)

world's forests. As of December 2015, 10.6 percent of Canada's terrestrial area and 0.9 percent of its marine territory have been recognized as protected. The country is home to more than 70,000 wild species, three quarters of which are ranked "secure" (not at risk).

Canadian residents perceive this natural environment in various ways, according to how they use nature around them: as a place for recreation and leisure, full of opportunities for outdoor activities such as hiking, camping, biking, sightseeing, and wildlife watching; as a determinant of health and well-being; as a basis for economic activities that generate income, for instance, through tourism, ecotourism, resort development, trade, and resource extraction, processing, and export (mining, forestry, and fisheries are some examples); as a link to cultural and heritage values and practices, particularly for Aboriginal people and those whose traditions include ocean- or land-related activities.

There is little doubt however that current production and consumption trends (globally but also regionally in North America and more locally in Canada) are not sustainable. Demand for more resources, particularly energy, food, and water, is growingly evident in Canada, while climate change impacts are also making their way into the everyday life through early snow, hot summers, abnormal weather patterns, and extreme flood or fire events across the country. About 12 percent of wild species in Canada are assessed as "at risk" or "maybe at risk"; forests are increasingly disturbed by fires, insects, and invasive species, and drought and wind storms; and 36 percent of the major fish stocks assessed in 2014 were classified as "cautious" or "critical".

Meanwhile, Canada's population has increased by 17 percent since 2001, from 31 million to 36.3 million people, while about 82 percent of total population in 2016 is considered urban, that is, living in a human settlement of more than 1000 people (Statistics Canada). Various indicators disclose the impact of this growing and urbanizing population: freshwater quality is considered "poor" to "marginal" at sites with agriculture or a mix of agriculture, mines, and/or high population density around them; ammonia (NH_3) emissions are 21 percent higher than 1990 due to agricultural activities; the country's total greenhouse gas emissions in 2014 were 20 percent above its 1990 emissions; the total amount of solid waste generated increased by 9 percent between 2002 and 2012; and the Air Health Indicator shows an upward trend in heart-and lung-related disease deaths attributable to ozone (O_3) exposure (Environment Canada).

Sustainability Policy in Canada

Before describing the current sustainability policies and legislation in Canada, we want to provide some background information on the related policy actors and processes in Canada and the historical steps leading up to today. The principal actors involved in the Canadian policy process are the elected officials (i.e. government at the federal, provincial/territorial, and/or local/municipal levels), the appointed officials (i.e. civil servants and/or judiciary), as well as scientists, researchers, civil society, Aboriginal peoples (First Nations), businesses, and other stakeholder representatives that may participate in the initiation, implementation, and evaluation of a policy. In theory, various stakeholders identify a problem and bring it to the attention of political parties or elected officials, who in turn propose policies and legislation which are adopted by the legislature and then implemented by the government as the executive branch. In practice, however, the policy process in Canada is more complicated; civil servants such as planners, technocrats, or sustainability experts are in reality involved in all stages and, along with governmental agencies, dominate the process, as they usually initiate, propose, implement, and evaluate policies.

The major federal policy actor in the Canadian sustainability landscape is Environment and Climate Change Canada (or Environment Canada as it was called before 2015), the federal department responsible for environmental issues and programs, natural resource preservation and use, and renewable resources and climate change policies. Before the creation of Environment Canada by the government of Pierre Trudeau in 1971, environmental responsibilities were dispersed among several government departments and agencies such as the Meteorological Service of Canada, the Canadian Wildlife Service, the Departments of Fisheries and Forestry, the Water Sector from the Department of Energy, Mines, and Resources, and the Air Pollution Control Division from the Department of Health and Welfare.

As in the case of the US Environmental Protection Agency, Environment Canada was established in response to events with significant environmental repercussions, such as the oil spill due to the ship Arrow sinking off the coast of Nova Scotia in 1970 and causing a large-scale pollution which is still evident in the area (Dwivedi et al. 2001). In addition, civil society movements and organized groups, such as the Society for the Promotion of Environmental Conservation (in the West) and Pollution Probe (in the East), started advocating for solutions to the then emerging issues of air and water pollution, hazardous wastes, and decline of natural resources. The activist NGO Greenpeace,

founded in 1971 in Vancouver B.C., was part of this wave of pro-environmental protection voices.

Despite the difficulties that Environment Canada encountered in the 1970s, such as issues inherent to integrating various existing departments and agencies, the department quickly launched programs for pollution control and abatement, and water management, as well as continued the services already offered by departments in the organization (Dwivedi et al. 2001). Resource management and conservation policies were gradually developed and put in place, thus marking a shift from remediation to prevention and from short-term action to long-term outlook. The economic recession of the late 1970s saw the environmental policies become a low priority for the federal government; however this trend was slowly reversed by the mid- to the late 1980s when issues such as climate change, environmental impacts of energy development, and acid rain emerged and were introduced in the task list of Environment Canada, which then moved to a more integrated approach for ecosystem management.

Environment Canada today operates under a clear mandate to preserve and enhance the quality of the natural environment, conserve Canada's renewable resources, forecast weather conditions and warnings, coordinate federal environmental policies and programs, and enforce related federal rules (Environment Canada, n.d.). Alongside Environment Canada, several organizations become increasingly involved in tackling environmental issues: non-governmental organizations at various geographical levels, research facilities and think tanks, citizen groups, Aboriginal peoples (First Nations), associations promoting industry interests, the media, and of course governmental institutions that share responsibilities for environmental and sustainability policies and programs.

The Canadian Constitution of 1982 confers the majority of environmental responsibilities to the provinces and territories. Since then, all provincial governments have either established their own ministries for environmental issues or transformed existing agencies to such ministries. Over the years, these provincial authorities developed cooperative relations and coordination platforms with Environment Canada and other federal agencies with related jurisdiction, as in many cases environmental problems require action at both national and regional levels (Dwivedi et al. 2001). Formal mechanisms of collaboration include dozens of joint federal-provincial Environmental Programs and the Canadian Council of Ministers for the Environment (CCME), the evolution of the Canadian Council of Resource and Environmental Ministries (CCREM), which was first held in 1961.

The CCREM initiated the National Task Force on Environment and the Economy (NTFEE) in 1986 in order to promote the integration of concerns and policies pertaining to the environment and the economy. The NTFEE report, which came out a few months after the Brundtland report in 1987, focused on proposing measures to achieve sustainable economic development in Canada. To a similar end, the National Round Table on the Environment and the Economy (NRTEE) was created a year later, with a mission to advise on how economic growth and prosperity can be achieved in an environmentally responsible way. The NRTEE actively included stakeholders such as businesses, NGOs, academics, and citizens in its processes, until it ceased its operations due to lack of federal funding in 2013.

Several significant pieces of policy and legislation were introduced in the years following the Brundtland report—and perhaps some of them were likely inspired by it. The Green Plan, a comprehensive action plan adopted in 1990, built upon the NTFEE work and aimed to guide the federal environmental policy for the ensuing years; it was an ambitious policy instrument but was abandoned in 1993. In the meantime, the adoption of the Canadian Environmental Protection Act (CEPA) in 1988 brought about an inclusive regulatory approach to the protection of human health and of the natural environment from toxic substances. The CEPA was revised in 1999 to emphasize the precautionary principle and pollution prevention rather than control, and to embrace intergovernmental cooperation; currently (2016) it is again under review by the Parliament's Standing Committee on Environment and Sustainable Development. The CEPA today incorporates the Clean Air Act (1970–1988), and in its purpose, it is complemented by other federal statutes, such as the Fisheries Act, the Canada Water Act, the Canadian Environmental Assessment Act, the Species at Risk Act, and the more recent Environmental Enforcement Act which strengthens and harmonizes the enforcement regimes of nine important environmental acts (Environment Canada, n.d.).

For Environment Canada, the concept of sustainable development first appeared in its 1987–1988 Annual Report; making sustainable development a reality for Canadians became the agency's principal focus ever since. To a similar end, the Commissioner of Sustainable Development was established in 1995 in the office of the Auditor General of Canada, with the aim of assessing sustainable development policies and strategies adopted and implemented by federal departments and agencies. While a lot of policies and laws were enacted and adopted from the late 1980s to the early 2000s at the national and provincial levels, Environment Canada and other federal departments experienced decline in their resources, particularly federal funding, and thus

in their capability to fulfill their mandate for environmental protection and achievement of sustainable development (Dwivedi et al. 2001).

An important step toward sustainability in Canada was made in 2008, when the federal government passed the Federal Sustainable Development Act (FSDA), thus delivering on the commitment the country made at the 2002 World Summit on Sustainable Development to develop a national strategy. Although the FSDA was amended in 2010 and again in 2013, its purpose remains to "provide the legal framework for developing and implementing a Federal Sustainable Development Strategy that will make environmental decision-making more transparent and accountable to Parliament"; through the FSDA, Canada defines sustainable development as the "ecologically efficient use of natural, social and economic resources" (Federal Sustainable Development Strategy, n.d.).

Under the FSDA, 26 federal departments and agencies, ranging from Agriculture Canada and Transport Canada to the Department of Justice and Employment and Social Development Canada, are responsible for preparing their own sustainability strategies—the Departmental Sustainable Development Strategies (DSDSs). In addition, the—now-called—Commissioner of the Environment and Sustainable Development (CESD) must review the Federal Sustainable Development Strategy (FSDS) and monitor and report on the contribution of federal departments to meeting the objectives of the FSDS (Office of the Auditor General of Canada, n.d.).

The first FSDS was adopted in 2010 by the Harper government and established an overarching planning and reporting framework for the goals, targets, and implementation strategies that existed already among federal government departments. It was organized under four themes—climate change and clean air, water quality and availability, nature protection, and environmental footprint reduction. Taking an environmental sustainability approach, the 2010–2013 FSDS intended to serve as an initial step toward the eventual inclusion of social, economic, and environmental considerations in governmental decision-making, as it recognized the impact of each aspect of sustainability on the other two (e.g. by mentioning how air pollution can lead to increased health-care costs and reduced productivity) (Environment Canada, n.d.).

The next FSDS, adopted for 2013–2016 under the same prime minister, focused mainly on building a comprehensive picture of governmental sustainability initiatives as well as an indicators framework for monitoring and progress assessment. Both strategies, 2010–2013 and 2013–2016, explicitly targeted federal departments and agencies by requiring from them to take action on the four themes mentioned above while also acknowledging the

contribution of other government levels, Aboriginal peoples, and other stakeholders in Canadian sustainable development.

Currently (2016), the third FSDS is in effect, adopted by the Justin Trudeau government in compliance with the FSDA. A broad range of stakeholders were involved in this strategy's development process: governmental bodies, non-governmental organizations, industry associations, academics and scientists, Indigenous groups, as well as citizens who were directly asked for input in February 2016 through a variety of public consultation methods such as email, online discussion spaces, stakeholder meetings and webinars, and social media (Federal Sustainable Development Strategy, n.d.).

The final text of the 2016–2019 strategy focuses on the overarching objectives of clean growth, healthy ecosystems, and safe, secure, and sustainable communities in Canada, and identifies targets, actions, and tools to implement these objectives and assess progress. The 13 more specific, long-term goals reflect the government's and the people's vision for Canada and are supported by several medium-term goals and short-term milestones: effective action on climate change, low-carbon government, clean growth, modern and resilient infrastructure, clean energy, healthy coasts and oceans, pristine lakes and rivers, sustainably managed lands and forests, healthy wildlife populations, clean drinking water, sustainable food, and safe and healthy communities.

Canada's current Federal Sustainable Development Strategy was developed and adopted and is being implemented with the country's international commitments in mind as well. With the exception of one "dark" moment in Canada's engagement in international environmental initiatives, that is, the withdrawal from the Kyoto Protocol in 2011, Canada has been active in the international environmental and sustainability arena for decades, for example, by:

- Committing to address environmental impact on trade in North America through participation in the NAAEC (see details in the previous section) and hosting its Commission for Environmental Cooperation since 1994;
- Supporting the United Nations Declaration on the Rights of Indigenous Peoples (2007) and particularly collaborating with First Nations within the framework of the FSDS;
- Adopting the 2020 Biodiversity Goals and Targets for Canada in alignment with the UN Convention on Biological Diversity and the 2011–2020 Strategic Plan for Biodiversity jointly approved by the Convention parties;
- Taking concrete action toward the achievement of the goals set by the UN Framework Convention for Climate Change Agreement that was signed in

December 2015 as the first ever universal and legally binding climate agreement; and

- Honoring the UN Development Agenda for 2030 and its 17 Sustainable Development Goals, as Canada endeavors to implement the SDGs through the FSDS, as is evident in Annex 3 that matches the FSDS goals, targets, and actions to the SDGs and their own targets. Canada also continues to participate in the UN Inter-Agency Expert Group which works for the development of effective, sound, and evidence-based indicators to measure contribution to the SDGs globally (Federal Sustainable Development Strategy, n.d.; Environment Canada, n.d.).

Performance measurement is deemed essential for the successful implementation of the FSDS and, for this purpose, the federal government engages three instruments: the triannual FSDS progress reports, the Departmental Sustainable Development Strategies, and the Canadian Environmental Sustainability Indicators produced and managed by Environment Canada with support from other federal departments. While the FSDS progress reports provide detailed information about the country's environmental outcomes, we shouldn't forget that most environmental responsibility lies with the provincial and territorial governments and therefore their own assessment tools are in a position to contribute to a more comprehensive measurement of Canada's environmental performance. Nevertheless, the Canadian Environmental Sustainability Indicators program provides the federal government with a broad range of indicators that are policy relevant, useful in decision-making, methodologically sound, and can be populated with available and reliable data. The list of indicators used to measure progress of the 2016–2019 FSDS goals is available in the FSDS website, as Annex 2 of the Strategy (Federal Sustainable Development Strategy, n.d.).

As a final note, we would like to offer two examples of successful sustainable development practices, one federal and one local/municipal. At the federal level, the Office of Greening Government Operations is an organization of Public Services and Procurement Canada and provides the federal government with advice and guidance toward reduction of the footprint of government operations. The Office's mandate is compatible with the fourth theme of the FSDS, as it supports federal institutions in operations such as green procurement and environmentally sound and secure disposal or recycling of electronic waste. In the past few years, the Office has succeeded in achieving a rate of 90–100 percent environmentally responsible acquisition and disposal of goods in most federal departments, mainly through procurement of

recycled paper and toner, furniture with reduced environmental impact, and safe recycling of electronic appliances.

At the local level, a best practice comes from the City of Burnaby near Vancouver, Canada, which employs a results-based approach and produces buildings at least 30 percent more energy efficient than traditional buildings. In 2010, the City of Burnaby approved a municipal zoning bylaw for the UniverCity community development that makes its building standards the greenest in North America (Roseland 2012). It is the first bylaw in North America that mandates specific green building practices as part of the development process. The bylaw promotes innovative building practices through an approach that requires a specific increase in efficiency rather than a specific type of energy certification and the outcome in UniverCity is buildings that are at least 30 percent more efficient than traditional buildings.

Lessons Learned

The historical progression of environment and sustainability related events in North America, and particularly in Canada, demonstrates the slow pace at which strategies are developed and operationalized and action is concretized at the international and national level. It took several decades for Canada to adopt and implement an integrated sustainable development strategy that contains guidelines and targets deemed essential for the country's path toward a sustainable future. More effort is yet required for the transition from the currently resource-dependent paradigm to a sustainable and even regenerative economy.

Canada today is striving to honor its international commitments, in light of the growing sustainability movement globally and the ongoing environmental, economic, and social issues the country faces within its borders. Items that need to be highly prioritized by governmental and non-governmental actors at various jurisdictional levels include: expanding awareness on problems and solutions, ensuring constant coordination and collaboration among stakeholders at various stages of the process, and committing to social sustainability by taking action toward intra-generational and inter-generational equity.

A critical element that will allow Canada to achieve its sustainability goals and contribute to the global SDGs faster and meaningfully is to strengthen the focus on local sustainability policies and practices. The increasing recognition of the role of human settlements as key components of both challenges and solutions follows naturally the exponential growth of urban population.

Thanks to the global SDG 11 for "inclusive, safe, resilient, and sustainable" human settlements in 2015 and the success of Habitat III in 2016, emphasis is now on sustainable urban and territorial development which requires integrated policy formulation and implementation, transformative renewal strategies, environment planning and management, planning compact and connected cities and regions, and inclusive and participatory planning. Canadian communities implement integrated community sustainability action plans for years and these experiences can be harnessed and escalated throughout the country and internationally.

Challenges and Barriers

Although the concept of integrated sustainable development is still not as popular among the public as scientists would have wanted, environmental and social awareness sees a constant increase in Canada through citizen-led initiatives such as food banks, information campaigns and petitions, community gardens, social entrepreneurship and social economy projects, efficient commuting initiatives (e.g. car-sharing and carpooling), and advocacy for affordable housing and equitable wages. At the same time, several challenges persist: poverty is evident even in a relatively wealthy country such as Canada; the state of the natural environment is declining due to logging, pollution, or land use change and development; private debt is increasing and so is the gap in incomes and purchasing power; and pollution causes health issues ranging from asthma to cancer.

Most policies in Canada today address environmental preservation or improvement, or economic growth, or social issues; few policies and measures contribute to all three simultaneously. It is thus imperative that environmental stewardship and economic development go hand in hand with social justice and active and fair engagement of as many stakeholders as possible. This "just" sustainability (Agyeman 2013) requires fundamental economic and social change to improve human well-being while protecting and restoring the natural environment. Achieving sustainability means that ecological integrity, social equity and cohesion, and economic prosperity need to be addressed in an integrated way. The key to moving sustainability discussion and action forward is to embrace a holistic approach in formulating and implementing strategies and policies that will identify and embrace the interconnections between problems, and foster inclusive and participatory solutions for long-term benefits.

Comprehensive and effective monitoring and assessment tools are also vital in order to gauge success and measure sustainability performance in ecological, social, and economic terms (Roseland 2012). Frameworks for implementing, monitoring, and assessing guide the path toward achieving sustainability goals by supporting decision- and policy-making: they can help develop, implement, and assess an initiative based on vision, values, and evidence while providing decision-makers with a "whole-systems" view of the initiative from a sustainability perspective throughout the entire process (Kates et al. 2005). As explained above, the Canadian FSDS has put a monitoring framework in practice through various mechanisms and indicators; however an integrated approach is required in this case as well. Successful sustainability monitoring and assessment entails tackling issues such as stakeholder engagement, context or place-specific challenges, and agreeing on shared theoretical grounds (definition of SD) and a practical vision (with objectives, boundaries, timescales, and meaningful and comprehensive indicators).

Achieving sustainable development in Canada will involve efforts from federal, provincial, territorial, and local governments, as well as the private sector, civil society, and academia. Some Canadian provinces and businesses are already demonstrating leadership in integrating sustainability considerations in their decision-making; however key issues—as well as significant opportunities—still exist. Canada will need to accelerate its planning and implementation efforts, particularly at the federal level, for initiatives that balance environmental integrity with economic prosperity and social equity. Since all UN member states have agreed to the SDGs and are bound to report on their progress, if Canada develops a rigorous and successful way to implement related plans and measure their performance in a holistic way, the country could be in an enviable position to share this expertise around the world as a sustainability leader.

Notes

1. For reasons of simplicity and for the purposes of this chapter, we will use the terms sustainable development and sustainability interchangeably, even though in the academic literature the first term refers to the process and the latter refers to the end goal (Sartori et al. 2014).
2. For more details on the example of Love Canal, see https://www.geneseo.edu/history/love_canal_history.

Further Reading

Agyeman, Julian. 2013. *Introducing Just Sustainabilities: Policy, Planning, and Practice*. London/New York: Zed Books.

Bayulken, Bogachan, and Donald Huisingh. 2015. A Literature Review of Historical Trends and Emerging Theoretical Approaches for Developing Sustainable Cities (Part 1). *Journal of Cleaner Production* 109: 11–24. https://doi.org/10.1016/j.jclepro.2014.12.100.

Berke, Philip R., and Maria Manta Conroy. 2000. Are We Planning for Sustainable Development? *Journal of the American Planning Association* 66: 21–33. https://doi.org/10.1080/01944360008976081.

David Suzuki Foundation. http://www.davidsuzuki.org/. Web Accessed 11 Sept 2016.

Dwivedi, O.P., John Patrick Kyba, Peter Stoett, and Rebecca Tiessen. 2001. *Sustainable Development and Canada: National and International Perspectives*. Peterborough: Broadview Press.

Environment Canada. http://www.ec.gc.ca/default.asp?lang=En&n=FD9B0E51-1. Web Accessed 15 Sept 2016.

Government of Canada's Federal Sustainable Development Strategy. http://fsds-sfdd.ca/index.html#/en/intro/. Web Accessed 18 Sept 2016.

Kates, Robert W., Thomas M. Parris, and Anthony A. Leiserowitz. 2005. What Is Sustainable Development? Goals, Indicators, and Practice. *Environment* 47 (3): 8–21. https://doi.org/10.1080/00139157.2005.10524444.

National Research Council. 2011. *Sustainability and the US EPA*. Washington: National Academies Press.

Office of the Auditor General of Canada. http://www.oag-bvg.gc.ca/internet/English/au_fs_e_370.html. Web Accessed 29 Sept 2016.

Roseland, Mark. 2012. *Toward Sustainable Communities: Solutions for Citizens and Their Governments*. 4th ed. Gabriola Island/British Columbia: New Society Publishers.

Salcido, Rachael. 2016. Reviving the Environmental Justice Agenda. *Chicago-Kent Law Review* 91 (1): 115–137.

Sartori, Simone, Fernanda Latrônico Da Silva, and Lucila Maria De Souza Campos. 2014. Sustainability and Sustainable Development: A Taxonomy in the Field of Literature. *Ambiente & Sociedade* XVII (1): 1–20.

Statistics Canada. http://www.statcan.gc.ca/eng/start. Web Accessed 17 Oct 2016.

United Nations. 2015. *Adoption of the Paris Agreement* (FCCC/CP/2015/L.9/Rev.1). Paris: United Nations.

WCED. 1987. *Report of the World Commission on Environment and Development: Our Common Future (The Brundtland Report)*. https://doi.org/10.1080/07488008808408783.

World Bank Open Data. http://data.worldbank.org/. Web Accessed 2 Aug 2016.

Worldwatch Institute. http://www.worldwatch.org/. Web Accessed 11 Sept 2016.

35

African Sustainability and Global Governance

Timothy M. Shaw

Background

Ironically, as many in "international relations (IR)" seek to make their field more "global" (Bergamaschi et al. 2017), two leading established Western governments, the USA and the UK plus many "alt" right parties and movements in the EU and the rest of Europe seek to limit or even reverse "globalization": an unanticipated divergence as global IR has become accepted and celebrated in Africa as elsewhere (Bischoff et al. 2016). And African contributions to the globalization of IR come from its own cities, civil societies, companies, medias, middle classes, supply chains, technologies, universities, and so on as corollaries of "emerging" classes/markets/powers/states, even universities, and so on (NB second Internet of Things (IoT) Forum Africa in Johannesburg, March 2018).

I attempt to build on the contributions of Pieterse (2011) on East-South relations (www.jannederveenpieterse.com) and Stuenkel (2016) on a non-Western world (www.nonwesternworld.com), using the current collections in the Palgrave Macmillan IPE Series by Gu et al. (2016) on the *The BRICS in International Development* and van der Merwe et al. (2017) on the *Emerging Powers in Africa*:

> *The South has risen at an unprecedented speed & scale…By 2050, Brazil, China & India combined are projected to account for 40% of world output in purchasing power parity terms…*

T. M. Shaw (✉)
Ottawa, ON, Canada

R. Brinkmann, S. J. Garren (eds.), *The Palgrave Handbook of Sustainability*,
https://doi.org/10.1007/978-3-319-71389-2_35

> *The changing global political economy is creating unprecedented challenges and opportunities for continued progress in human development.* (UNDP 2013: 1 and 2)

> *Africa's economic growth remained resilient in 2015 amid a weak global economy, lower commodity prices & adverse weather conditions in some parts of the continent. Real GDP grew by an average of 3.6% in 2015…Africa remained the second fastest growing economy in the world (after emerging Asia)….* (OECD 2016)

This chapter argues that the diversion of the USA, UK, and the EU away from "global development" toward their own "internal" difficulties may be positive for Africa, giving it unprecedented space to advance its own "developmental regionalism" (DR) (Shaw 2016). "African agency" (Shaw 2015a, b) may yet be able to advance sustainable development/global goals in part through DR. Thus, in the middle of 2016, East Africa declined to sign an Economic Partnership Agreement (EPA) with the EU yet the Tripartite Free Trade Agreement (TFTA) also remains unimplemented with implications for the possibility of an effective Continental Free Trade Area (CFTA). And over the next five years, Eastern Africa will be pumping oil and gas from South Sudan and northern Kenya and Uganda to northern Mozambique (Warner and Shaw 2018).

As a central feature of "global" development, now including the Sustainable Development Goals (SDGs) or "global goals", African "development", both applied and analytic, was at a significant conjuncture in the symbolic year of 2015 (Hanson et al. 2018; Shaw 2015a, b, c): what prospects/directions for sustainable human development/security after 2015 (www.post2015.org, www.beyond2015.org)? Can the African political economy (Cilliers and Sisk 2013, www.agenda2063.au.int) continue to aspire to being "hopeful" rather than "hopeless" as *The Economist* has come to articulate its revisionist rethinking (Kararach et al. 2015; Taylor 2015)? Yet in mid-2016, it reverted to caution that the continent's democracies were increasingly "fragile" (The Economist 2016).

Such concerns are becoming ever more salient as the global economy slows in the middle of the second decade of the new millennium (Hanson et al. 2012; Noman and Stiglitz 2015): from crash in commodity prices 2014–2016 to Chinese and other currency devaluations along with declining stock prices, especially among the BRICS/EMs (IMF 2016): who are the shorter-/longer-term winners and losers among states, sectors, companies, generations, and technologies?

Case Study: African Sustainability and "Global IR"/Global Governance

This chapter is informed by the PhD thesis research of four in the first cohorts of the new PhD at UMass Boston on Global Governance and Human Security. I have been proud to help mentor Timothy Adivilah, Jeremiah Asaka, Abigail Kabandula, and Jason McSparren, all defending their dissertations in 2017/2018. They focus on mercury poisoning in the gold ASM sector in northern Ghana, sustainable development in northern Kenya, non-traditional security (NTS) in the Horn around Somalia, and national/local accountability in the gold industry in Mali, respectively.

As a contribution to comparative sustainability, this chapter seeks to juxtapose notions of development with emerging debates around the "sharing" or "gig" economy: "the IoT", especially the work of Manuel Castells on "information" (www.manuelcastells.info) and Clayton Christensen on "disruption" (www.claytonchristensen.com and www.christenseninstitute.org). The former has recently produced an edited collection on *Reconceptualizing Development in the Global Information Age* (Castells and Himanen 2014), and the latter has been chided by *The Economist* (2015) for trying to monopolize the notion of "disruption" by limiting it to low-end newcomers when it may have become more widespread than Christensen originally conceived two decades ago; hence the non-state, transnational Facebook, Apple, Netflix and Google (FANG) acronym superseding BRICS and even TICK as the icon for growth:

> *…think of the threat that Google poses to carmakers, Facebook to newspapers & Apple to television stations. Back in 1995, Mr Christensen struck fear into executives by warning them that they could be put out of their jobs by companies they had never heard of. Today the biggest threats may come from people that talk about them every day.*

Such disruption raises the question of whether "African agency" (Brown and Harman 2013) may be a fleeting or sustainable phenomenon. So, is the UNECA (2012) advocacy of "developmental state" aspirations a pipe dream? Can earlier preoccupations of the EU facilitate developmental interregionalism (Doidge 2007) in Africa? Can the continent refocus on realizing SDGs after its disappointments with the Millennium Development Goals (MDGs) (Kararach et al. 2015)? And are "fragile states" (www.foreignpolicy.com) or "ungoverned spaces" readily separable from others as myriad, dynamic mobile communications enable the diaspora to connect, remit, radicalize, and so on 24/7 (Laakso and Hautaniemi 2014)?

In short, Africa presents some interesting cases of IT innovation (www.itnewsafrica.com), particularly from below: from the repair of second-hand

Japanese cars and trucks, especially mini-buses, to proliferating uses of cell-phones. And especially given distances on the continent, sensors on cars and trucks for tire or oil pressures as well as for more secure logistics for supply chains are invaluable; similarly, biochip transponders on wild or domestic animals or monitors on pipelines and communication towers? Can Africa adapt green energy and electric vehicles (EVs) to its context? If "DR" can advance such IoT, then it is likely to be adopted, despite the decline of the EU (NB IDS 2016 on ten frontier technologies).

Meanwhile the notion of "global IR" (a more globalized, inclusive analysis and practice of "IR") is beginning to gain traction, with implications for the character of South-South relations (Bergamaschi et al. 2016 and van der Merwe et al. 2016). It was initially advocated by Tickner and Waever (2009) and was then espoused by the leading IR professional association, the International Studies Association (ISA) (www.isanet.org) as its theme for its February 2015 annual conference—"Global IR and Regional Worlds: a new agenda for international studies"—and in February 2017 in Baltimore; the globalization of IR was orchestrated in part by fellow Canadians, Amitav Acharya, T.V. Paul, and Andrew Grant. And I am especially pleased that my two coedited collections on African IR have gone into revised paperback editions mid-decade (Dunn and Shaw 2013; Cornelissen et al. 2015), reflective of growing recognition of African and other contributions to "global IR".

To advance analysis of the prospects for sustainability on the continent, I build on the increasingly familiar and compatible concepts (Roger and Dauvergne 2016) of "the transnational" (Findley et al. 2014; Hale and Held 2012; Mukherjee-Reed et al. 2012) and "global governance" (Harman and Williams 2013; Weiss and Wilkinson 2014a, b; World Bank 2017) as together they advance analysis of transnational African relations and regulation symbolized by the Kimberley Process (KP) and Extractive Industries Transparency Initiative (EITI) (cf. Bernstein 2011 on another KP—Kyoto Protocol—and ISEAL Alliance) and now Africa Progress Panel (APP) (www.africaprogresspanel.org).

My own perspective on contemporary transnational relations on the continent was informed by being a grad student at Makerere in the late-1960s with Ali Mazrui (Shaw 2017). His then-unfashionable concern with transnational culture, language, race, and religion has since proven to be prophetic as evidenced by powerful legacies edited by Adem and Njogu (2017) and Njogu and Adem (2017): seminal contributions to a very authentic African voice in global IR.

Furthermore, given the ubiquity of "private" regulation (cf. Bernstein 2011 on ISEAL Alliance), such as fair trade/organic certification (Hudson et al. 2013), even developmental states/regions do not really/authoritatively control burgeoning new sectors like mobile phones/finance, broadband internet, brands/franchises/logistics (particularly South African), ATMs (SWIFT is a non-state network

controlled by the world's banks (www.swift.com)). And a range of non-state rules on conflict-free minerals, diamonds, fish, forests symbolized by FSC, KP/KP, ISEAL Alliance, MSC, and so on (www.isealalliance.org), set limits on statist or presidential ambitions even corruption and capital flight/money laundering.

Finally, can African coalitions reflect a changing world in which the BRICS, especially China and India, are displacing the EU as its primary partner? Such a transformation has led Jan Nederveen Pieterse (2011, 22) to assert that the established North-South axis is being superseded by an East-South one in the second decade of the twenty-first century (Christensen and Xing 2016), that of the Mexico, Indonesia, Nigeria and Turkey (MINT)/Mexico, Indonesia, South Korea and Turkey (MIST)/TICK or "emerging economies" now joined by transnational IT, from Facebook, Alphabet, Apple, Netflix and Google (FAANG) to Baidu, Alibaba, and Tencent (BAT):

> *…the rise of emerging societies is a major turn in globalization…North-South relations have been dominant for 200 years and now an East-South turn is taking shape. The 2008 economic crisis is part of a global rebalancing process.*

The latest IMF *Annual Report* 2017 (p. 18) indicates that "over the past 20 years", trade between Africa and China "has risen more than 40-fold". "While falling commodity prices hurt Africa in the short term, China's shift to more consumption is an opportunity for Africa to accelerate its much-needed structural transformation".

To situate post-2015, given recent upsets in commodity, currency, and other markets, this chapter juxtaposes a set of parallel/overlapping perspectives to consider whether the several regional "worlds"—from North Atlantic/Pacific and onto Eurozone Portugal, Ireland, Iceland, Greece and Spain (PIIGS) versus "second world" (Khanna 2009) of BRICS/CIVETS/MINT/MIST/Venezuela, Indonesia, Saudi Arabia, Turkey and Argentina (VISTA) and now TICK—have grown together or apart as global crises and reordering have proceeded (see myriad heterogeneous analyses such as Cooper and Antkiewicz 2008; Cooper and Flemes 2013; Cooper and Subacchi 2010; Economist 2012; Gray and Murphy 2013; Lee et al. 2012; Lesage and Van der Graaf 2015; Pieterse 2011; USNIC 2012; WEF 2012; World Bank 2012; O'Neill 2011). The continent enjoyed a surge in FDI to almost US$90 billion in 2014 according to a report from fDi Intelligence in the *Financial Times* mid-May 2015, concentrated in sectors like energy (Hicks 2015), real estate, and communications (de Waal 2015) and in more mature frontier markets (FMs) like Egypt, Kenya, Morocco, and Mozambique.

As global investment in the BRICS and other EMs peaked (Armijo and Katada 2014), Africa became the continent with the most promising FMs.

Africa is increasingly able to attract new sources of finance such as non-traditional donors (Sumner and Mallett 2012) like the Gulf states, Korea, and Turkey, SWFs and global pension funds, remittances from myriad diasporas, and new foundations like Annan, Clinton, Gates, Ibrahim, and so on. Its growth trajectory may outlast that of many of the BRICS even if the risks are greater; so continent-wide and country-specific Exchange Traded Funds (ETFs) have proliferated (e.g., Van Eck Vector Africa Index ETF (www.vaneck.com) and South Africa's first from the Johannesburg Stock Exchange (JSE) (www.jse.co.za) at the start of the new century, now over 20 available).

In 2013/2014, Africa's stock exchange performance was enhanced by financial and telecommunications sectors rather than energy or mining and by SMEs rather than large-caps. And at the start of 2017, Canada's Fairfax launched its own US$56 million African investment fund with a focus on political economies like Botswana, Egypt, Ethiopia, Kenya, Mauritius, Nigeria, Rwanda, and Republic of South Africa (RSA). Its risk assessment reads like a comparative politics text, citing the Ibrahim Index, and so on, and it emphasizes demand from the continent's emerging middle class (www.fairfaxafrica.com).

As indicated later, FDI reached US$50 billion in 2013. The JSE is one of the world's top 20 stock markets, playing an increasingly continental role and being part of the BRICS alliance and the "New BRICS Bank"; its index stood around 50,000 mid-decade having risen from 5000 two decades earlier. The JSE can increasingly claim to be the regional financial hub, advancing FMs throughout the continent.

In turn, especially in Africa, "contemporary" "global" issues—wide varieties of ecology, gender, governance (de Waal 2015; Henley 2015), health, norms, technology, and so on—have increasingly confronted established analytic assumptions/traditions and actors/policies leading to myriad "transnational" coalitions and heterogeneous initiatives/processes/regulation schemes as previewed in Bernstein (2011); Bernstein and Cashore (2008); Dingwerth (2008); Hale and Held (2011). These impact prospects for sustainable economic, environmental, health, and natural resource governance in Africa as elsewhere: a unique mix of high and low tech, advancing sustainability through human security as well as human development.

Lessons Learned: Emerging Economies/States/Societies/Universities

Africa's economy is growing steadily. Last year average growth was 3.9% & it is set to accelerate this year…FDI is helping to spur growth. It is expected to reach $55 billion in 2015, 20% higher than in 2010. Inflows of capital are increasingly focused on less

resource-rich countries, as investors target the continent's booming middle classes. The amount of investment into technology, retail & business services increased by 17 percentage points between 2007 & 2013. FDI is also becoming a two-way affair. Last year Africa's outward investment hit $11.4 billion, up nearly two-fifths since 2011–12. ("Investment in Africa" box *The Economist* 415 (8940) 30 May 2015, 89)

The salience of "emerging markets", largely outside both the EU and Africa, has led to debates about the similarities and differences among emerging economies/middle classes/multinational companies/states/societies (Christensen and Xing 2016) and now universities/business schools, and so on, for example, rising role of Chinese, Korean, Turkish, and other analysts from TICK (e.g., Turkish journal/OA journal on "Rising Powers and Global Governance" [www.risingpowersproject.com]).

These are informed by different disciplinary cannons, for example, by contrast to Andrea Goldstein (2017) or Andreas Nolke (2014) on Emerging Market Multinational Corporations (EMNCs), Pieterse (2011) privileges sociologically informed "emerging societies". In turn, especially in foreign policy (FP), there are burgeoning analyses of emerging powers, regional and otherwise (Flemes 2010; Jordaan 2003; Nel and Nolte 2010; Nel et al. 2012), in Africa as elsewhere.

Despite the US subprime and EU euro crises early in the twenty-first century, FDI in Africa continues to grow, reaching US$50 billion in 2013 more than double Official Development Assistance (ODA), primarily from outside the OECD: China, India, and Turkey, and myriad SWFs and State-Owned Enterprises (SOEs). The drivers are increasingly services for the burgeoning middle class (e.g., banking, insurance, real estate, retail, telecoms, tourism, etc.) (see www.fairfaxafrica.com); plus food and energy (www.un.org/africa/osaa). *The Globe & Mail* suggested in its *Report on Business Weekend* on 11 July 2015 (p. B4) that "Africa's clicking"; and I would add that the clicking is by the poor in informal sectors as well as by middle classes in the formal. Hence, the need to rethink "sustainable development" mid-decade beyond traditional industrialization and agriculture and toward digital and IoT, including bottom-up (Robertson and Moran 2013; Rowden 2016).

With new energy discoveries and investments, a second tier of oil producers has emerged after Nigeria and Angola: Equatorial Guinea, Congo-Brazzaville, Gabon, South Sudan, and now Ghana, with Kenya and Uganda (Mbabazi 2013) eager to join (Hicks 2015) (www.africanoilcorp.com; www.tullowoil.com). Liquified Natural Gas (LNG) is now exported from Nigeria, Equatorial Guinea, and Mozambique, with the latter able to challenge the dominance of Qatar and Australia by 2020. Hence, the interest of Exxon-Mobil (US$2.8 billion in March 2017) and Qatar buying into ENI and Anadarko holdings in offshore northern Mozambique mid-2016/early 2017.

By the turn of the century, the Newly Industrialising Countries (NICs) then BRICs/BRICS pointed to another way to development other than the EU's offer to the African, Caribbean and Pacific Countries (ACP) of EPAs or traditional inter-regionalism (Doidge 2007); such "developmentalism" (Kyung-Sup et al. 2012) has now reached Africa (Hanson et al. 2014; UNECA 2012). But, while the "global" middle class grows in the South (Dayton-Johnson 2015)—increasingly major cruise companies like Carnival, Royal Caribbean, and Norwegian sail out of Shanghai and Singapore as well as Miami—so do inequalities along with non-communicable diseases (NCDs) like cancers, heart diseases, and diabetes. In turn, global health insurance agencies provide coverage and care globally; Bupa alone has 29 million subscribers in 190 countries serviced by 80,000 employees (www.bupa.co.uk).

Africa has advanced as well as benefitted from mobile technologies, extending its own IoT, from cell phones to mobile finance such as M-Pesa, developed in Nairobi at its iHub (www.ihub.co.ke), its mini-MIT or—Waterloo or—Cambridge (UK); after a decade, in 2016, it totaled six billion transactions. IBM opened a research lab in Kenya's capital mid-decade, and now a trio of Kenya's major universities is building a basic laptop computer for over a million school children with an initial US$170 million from the government in 2015. Several Nairobi universities are to offer an MSc in mobile finance supported by M-Pesa, Safaricom, and so on, and the latter has developed its own Kenyan version of Uber hailing app. iHub partners with several local and global IT companies such as Chase Bank, Google, Hivos, Intel, IBM, Microsoft, Omidyar, Oracle, Nation Media Group (connected to the Aga Khan Foundation (AKF), hence the AK University especially medicine/hospital, Serena Hotels, etc.), Safaricom, Samsung, and so on (www.ihub.co.ke). And during its late-October 2016 Huawei Southern Africa Partner Summit at the Huawei Innovation and Experience Centre in Johannesburg, Huawei signed music cooperation contracts with global and local music vendors (www.itnewsafrica.com), an indicator of African "sort power":

> *Under the global digital wave, Africa shows great demand for digital services like music, game & video etc. According to Huawei's analysis, in five years year-on-year growth will be around 40%. However, there still remains a big gap between the growing demands & the digital productions.*

And if SWFs can advance a more equitable, developmental, and sustainable "sharing economy" in the UK (Lansley 2016): why not Africa?

The proliferation of states along with capitalisms post-bipolarity has led to a parallel proliferation of regions (Haastrup and Eun 2014), especially if diversities of non-state, informal even illegal transnational "regions" are so

considered rather than just traditional inter-state organizations (Fanta et al. 2013). And the Eurozone crisis concentrated in the PIIGS, now reinforced by the unprecedented migration "invasion" and the drama of Brexit, has eroded the salience of the EU as model (Dosenrode 2015), leading to a growing recognition of a variety of "new" regionalisms (Flemes 2010; Shaw et al. 2011).

In turn, inter-regionalisms, have proliferated from those around the EU and ASEAN (Doidge 2007) toward novel multilateralisms around emerging donors—for example, China-African Forum on China-African Cooperation (FOCAC) (www.focac.org) meeting in RSA end-2015, Japan's parallel TICAD gathering in Nairobi mid-2016 (www.mofa.go.jp)—and a proliferation of focused arrangements ex-China like its Asian Infrastructure Investment Bank (AIIB) (www.aiibank.org), Chang-Mai Initiative (CMI) and CMI Multilateralization, SCO (www.sectsco.org), the BRICS' New Development Bank (www.brics6.itamaraty.gov.br; www.g8g20.utoronto.ca; www.thebrics-post.com), and now the very macro-regional One Belt One Road (OBOR). Will the EU's difficulties mid-decade impact the hierarchy of inter-regionalisms, leading away from North-South and toward more East-South? Mid-decade, emulating China and its AIIB, AfDB, ACBF, donors and African companies have established "Africa 50" for the continent to finance its own infrastructure through indigenous developers and investors (www.africa50.com) as reflected in Africa Investment Report 2016 (www.analyseafrica.com).

Such regionalisms, with their potential for sustainability, can now be claimed to include instances of "DR" or "African agency" (Brown and Harman 2013; Lorenz and Rempe 2013) like South African franchises and supply chains such as MTN and DStv reaching to West Africa plus the recently formalized Trilateral FTA among COMESA, EAC and SADC (T-FTA) (Hartzenberg et al. 2012). Also, there are new regional formulations around older/newer regional conflicts like the Nile Basin Initiative (NBI) and International Conference on the Great Lakes Region (ICGLR) plus the regional as well as global dimensions of, say, piracy off the coast of Somalia and IGAD's role in the endless conflicts in Somalia and South Sudan (ACBF 2014; Hanson 2015).

Finally, the development of SADC has been advanced by compatible forms of sub-regionalism such as the Maputo Corridor and cross-border peace parks between South Africa and Botswana/Mozambique/Namibia. And elsewhere, Africa is installing pipelines as well as broadband cable in the Sahara, coast of West Africa and, shortly, Eastern African oil and gas fields (Hicks 2015) (www.tallowoil.com; www.africaoilcorp.com). Symptomatically, in Mozambique, NOCs from China, India, and so on partner with Anadarko and ENI and now ExxonMobil; some US$25 billion will be required to construct the LNG trains. As climate change increases, the continent is likely to

need water pipelines too for irrigation. Global value chains (GVCs), hubs, logistics, and so on, all part of sustainable development and DR mid-decade, are largely defined by "private" or transnational interests and rules rather than states.

Challenges: From Non-Traditional Security to Water, Energy, and Food Nexus

Africa may have been growing at an unprecedented rate in the twenty-first century but it has also had to confront a growing range of unanticipated and unfamiliar security challenges which complicate sustainability: from NTS to climate change or water, energy, and food (WEF) nexus (Kabandula and Shaw 2016). And, encouraged by the EU and the USA, its interstate regional institutions—the RECs—have been further redefined in terms of AU "regional security" roles, especially conflict prevention/peace building (Kobayashi 2016). Given the closeness of Eur-African ties, NTS cannot be isolated south of the Mediterranean, despite EU attempts in agreements and monies with Turkey, West Africa, and the Horn such as the mid-decade Africa Trust Fund of €2 billion. I now highlight the impacts on sustainability of NTS and a burgeoning range of "global" issues.

First, NTS threats and myriad novel and orthodox responses (Peter 2014) stretch from intra- and extra-continental migrations and flows of drugs and guns—citizen insecurity—to fundamentalist or radicalized jihadist networks, loosely connected to global *Al-Qaeda* or "Islamic State"; for example, *Al-Shabab* in the Horn and Boko Haram in West Africa. These all complicate, even retard, prospects of sustainable development, particularly if human security includes notions of personal, psychological safety.

The burgeoning drug supply chain from South America to Europe has been recognized through the West African Commission on Drugs (WACD) (www.wacommissionondrugs.org). WACD (2014) published its report on "Not Just in Transit" in mid-2014 and a variety of analyses, confidential and otherwise, have been produced about the dangers of "radicalization" in both East and West Africa (Harman 2014). *Al-Shabab* generates particularly difficult dilemmas for Kenya and neighbors like Djibouti and Ethiopia, given their established, sometimes affluent, Somali citizens, especially around "little Mogadishu", the nearby Eastleigh suburb of Nairobi (Carrier 2015). The mix of immediate and distant diasporas as sources of remittances along with ideas and weapons presents challenges for states and NGOs alike, let alone global

remittance franchises like Western Union and Money Gram and now Dahabshiil (www.dahabshiil.com), what *The Economist* referred to end-2015 (17 October 2015, p. 78) as the "Somali star" of banking in Africa.

Varieties of private security—formal and informal, legal and illegal—have developed on the continent particularly since 2000, from ubiquitous guardians of property, now especially land and food, to banking, cyber, migration, and remittances security. Some private security professionals learned their trade with the US Army in Afghanistan or Iraq and demand shows no signs of abating given recent *Al-Shabab* attacks in Kenya and *Al-Quaeda* in Mali. Moreover, such jihadist groups may profit from informal trade, including oil, as well as attract radicalized youth, primarily male, from the global North. NTS presents challenges to sustainability (Kobayashi 2016).

And given seemingly exponential climate change, increasing recognition of the emerging nexus WEF/land is likely to generate novel forms of tension, juxtaposing so-called "global" issues and NTS (www.water-energy-food.org; www.weforum.org). Climate, energy, food, land, and water security are likely to generate exponential demand post-COP21 as Africa's population expands, particularly its middle class.

Second, a growing number of global issues is increasingly recognized to be arising in Africa, as in the rest of the global South as well as resulting from excessive consumption/pollution in the North such as NCDs, like diabetes, cancers, heart disease, and so on; hence the hybrid NCD Alliance of four global federations with leading drug companies, 170 national associations, and so on (www.ncdalliance.org). In the immediate future, these issues will include environmental and other consequences of climate change and health viruses/zoonoses. They will also extend to myriad computer viruses and cybercrime (Kshetri 2013). In response, the Gates Foundation with others (www.gatesfoundation.org) has advanced the Global Alliance for Vaccines and Immunizations (GAVI) (www.gavialliance.org) and the Alliance for Green Revolution in Africa (AGRA) (www.agra-alliance.org).

The ubiquity of the Gates Foundation in African development this century, especially health and now agriculture (Moran 2013), is symptomatic of burgeoning transnational relations on the continent which trump established intergovernmental institutions like the WHO or FAO. Africa post-2015 will be different but not necessarily as anticipated in UN debates around SDGs/global goals (www.post2015hlp.org; www.post2015.org; www.beyond2015.org). Similarly, the continent will benefit from the US$200 million Global Innovation Fund (GIF) of four major OECD donors (Australia, Sweden, UK, and USA) plus the Omidyar Network, intended to improve the lives of the world's poorest people (www.globalinnovation.fund) as global commodities crash.

The prospects for new African energy regions have slowed somewhat as the global commodities bust intensified mid-decade (www.africa-energy.com), especially the promising eastern African energy region from South Sudan through East Africa to northern Mozambique (www.eac.int/energy). But Exxon-Mobil and Qatar expressed an interest in buying into Eni-Anadarko's holdings in northern Mozambique mid-2016/start 2017: when will ambitious plans for extraction, pipelines, LNG, and so on now get underway post-2015 (Hicks 2015; www.eaenergyforum.org)? And what prospects for the peripheries of such emerging regions, like Somalia with its ubiquitous and connected diasporas (Laakso and Hautaniemi 2014)?

Emerging out of an increasingly high-tech wired world with its very visible and ubiquitous mobile "poles" or "towers" and underground/undersea broadband wires, proliferating mobile technologies increasingly facilitate the informal and illegal as well as otherwise. The "informal sector" is increasingly recognized in the "discipline" of "anthropology", and so on (Hirschfield 2015; Morris and Polese 2015) as the "illegal" in IPE (Friman, 2009; Naylor 2005), informed in part by the annual Small Arms Survey (www.smallarmssurvey.org), now joined by Andrew Feinstein (2012) on *The Shadow World: Inside the Global Arms Trade* (www.theshadowworldbook.org); plus Offshore Financial Centers (OFCs) documented in Findley et al. (2014) (*Global Shell Games: Experiments in Transnational Relations, Crime and Terrorism*) (for Table of Contents (ToC), first chapter, etc. see: www.globalshellgames.com).

Similarly, Transnational Organised Crime (TOC) is increasingly transnational with a proliferation of young/male gangs from myriad states. In response, the fields of African, development and global studies as well as IPE need to develop analyses and prescriptions from the established informed annual Small Arms Survey (SAS) and Latin American, then Global and now West African Commissions on Drugs and Health (WACD), all with profound implications for sustainability.

Further Reading and Analysis

In conclusion, I pose the possibility of sustainable African capitalism 2017 being different from others because it might yet find its own niche as some BRICS, EU, and USA economies decline if not shrink: what implications for sustainability? The mid-decade combination of Trump in the White House, UK Brexit and repression in Turkey, following the EU's Eurozone crisis and migration invasion, and so on, has further increased the space for African definitions of sustainability. ACP post-2020 will be less neocolonial and more diverse/flexible than before to reflect exponential global divergencies (Montoute 2017; Montoute and Virk 2017). And China is increasingly recognized as the exponential global driver?

African FP (Warner and Shaw 2018) needs to connect to FAANG and now BAT and the "sharing economy" as both have an interest in "disruptive innovation", with implications for sustainability. Global SWFs and African ETFs have a mutual interest in connecting FAANG and BAT plus EVs to Africa to advance sustainability.

In conclusion, I juxtapose five changes which may impact sustainability in Africa, reinforced by the disarray in and around the USA, UK, and EU mid-decade:

a) The world monetary system is now triangular—the euro and yuan (Xing 2013) as well as the US$ (Vermeiren 2014)—but global growth is largely a function of another trio of markets—China (especially its alternative behemoths to FAANG: BAT) and India as well as the USA…but not the EU, especially after Brexit;
b) Shift in the direction and concentration of global supply/value chains, including broadband internet and airline (e.g., EgyptAir, Ethiopian, and SAA in Star Alliance and Kenya in Skyteam) and container hubs away from South-North toward South-East (Christensen and Xing 2016, Pieterse 2011);
c) "Young shoots" of a digital revolution advancing a "sharing economy" through the "IoT", reinforced by FAANG and BAT, but this may exacerbate inequalities between generations and the urban-rural divide unless managed judiciously: onto further dependency and/or agency (www.ihub.co.ke; www.itnewsafrica.com);
d) Continued evolution in heterogeneous, hybrid, multi-stakeholder communities to incorporate SOEs, SWFs, pension funds, ETFs, and so on, especially from the BRICS and other EMs/FMs (Besada and Kindornay 2013, Hale and Held 2012, Mukherjee-Reed et al. 2012, Sumner and Mallett 2012); and
e) In response to inequality and alienation, further escalation of radicalization/ fundamentalisms, leading to redefinitions of human/citizen security and regional/ global citizenship post-2015: onto the redefinition/reordering of global goals or global goods.

In short, if Africa can continue to rise, then it may itself become a disruptor by 2025, advancing its own varieties of sustainability in which its IoT innovations and related services—such as design, drones, fashion, film, foods, mobile finance, and crowdsourcing (IDS 2016), music—facilitate its global role beyond commodities; all reinforced by its global diaspora continuously connected by IT and increasingly AI.

References

ACBF. 2014. *Africa Capacity Report 2014: Capacity Building for Regionalism in Africa*. Harare.

Adem, Seifudein, and Kimani Njogu, eds. 2017. *Global African & Universal Muslim: Essays in Honour of Ali A Mazrui.* Banbury: Ayebia Clarke, Forthcoming.

Armijo, Leslie Elliott, and Saori Katada, eds. 2014. *The Financial Statecraft of Emerging Powers: Shield & Sword in Asia & Latin America*. London: Palgrave Macmillan.

Bergamaschi, Isaline, et al. 2016. *South-South Cooperation Beyond the Myths*. London: Palgrave Macmillan.

Bergamaschi, Isaline, Phoebe Moore, and Arlene B. Tickner, eds. 2017. *South-South Cooperation Beyond the Myths: A Critical Analysis of Discourses, Practices & Effects*. London: Palgrave Macmillan.

Bernstein, Steven. 2011. Legitimacy in Intergovernmental & Non-state Global Governance. *Review of International Political Economy* 18(1): 17–51. February.

Bernstein, Steven, and Benjamin Cashore. 2008. The Two-Level Logic of Non-State Market Driven Global Governance. In *Authority in the Global Political Economy*, ed. Volker Rittberger and Martin Nettesheim, 276–313. London: Palgrave Macmillan.

Besada, Hany, and Shannon Kindornay, eds. 2013. *The Future of Multilateral Development Cooperation in a Changing Global Order*. London: Palgrave Macmillan for NSI.

Bischoff, Paul-Henri, Kwesi Aning, and Amitav Acharya, eds. 2016. *Africa in Global International Relations: Emerging Approaches to Theory & Practice*. Abingdon: Routledge.

Brown, William, and Sophie Harman, eds. 2013. *African Agency & International Relations*. Abingdon: Routledge.

Carrier, Neil. 2015. *Little Mogadishu: Eastleigh, Nairobi's global Somali Hub*. London: Hurst.

Castells, Manuel, and Pekka Himanen, eds. 2014. *Reconceptualizing Development in the Global Information Age*. Oxford: OUP.

Christensen, Steen Fryba, and Li Xing, eds. 2016. *Emerging Powers, Emerging Markets, Emerging States: Global Responses*. London: Palgrave Macmillan.

Cilliers, Jakkie, and Timothy D. Sisk. 2013. *Assessing Long-Term State Fragility in Africa: Prospects for "More Fragile" Countries*. Johannesburg: ISS, Monograph #188.

Cooper, Andrew F., and Agata Antkiewicz, eds. 2008. *Emerging Powers in Global Governance: Lessons from the Heiligendamm Process*. Waterloo: WLU Press for CIGI.

Cooper, Andrew F., and Daniel Flemes, eds. 2013. Special Issue: Emerging Powers in Global Governance. *Third World Quarterly* 34 (6): 943–1144.

Cooper, Andrew F., and Paola Subacchi, eds. 2010. Global Economic Governance in Transition. *International Affairs* 86 (3): 607–757. May.

Cornelissen, Scarlett, Fantu Cheru, and Timothy M. Shaw., eds. 2015. *Africa & International Relations in the 21st Century*. London: Palgrave Macmillan. Revised paperback edition.

Dayton-Johnson, Jeffrey, ed. 2015. *Latin America's Emerging Middle Class: Economic Perspectives*. London: Palgrave Macmillan.

De Waal, Alex, ed. 2015. *Advocacy in Conflict: Critical Perspectives on Transnational Activism*. London: Zed.

Dingwerth, Klaus. 2008. Private Transnational Governance and the Developing World. *International Studies Quarterly* 52 (3): 607–634.

Doidge, Mathew. 2007. *From Developmental Regionalism to Developmental Inter-Regionalism: The EU approach*, NCRE Working Paper 07/01. Canterbury, NZ, July.

Dosenrode, Soren, ed. 2015. *Limits to Regional Integration*. Farnham: Ashgate.

Dunn, Kevin C., and Timothy M. Shaw, eds. 2013. *Africa's Challenge to International Relations Theory*. London: Palgrave. Revised Classics pb edition.

Economist. 2012. *The World in 2013*. London. www.economist.org/theworldin/2013.

———. 2015. Schumpeter: Disrupting Mr Disruptor ((417) 8966, November 28: 63).

———. 2016. Africa's Fragile Democracies, August 20.

Fanta, Emmanuel, Timothy M. Shaw, and Vanessa Tang, eds. 2013. *Comparative Regionalism for Development in the Twenty-first Century: Insights from the Global South*. Farnham: Ashgate for NETRIS.

Feinstein, Andrew. 2012. *The Shadow World: Inside the Global Arms Trade*. London: Penguin.

Findley, Michael G., David L. Nielson, and J.C. Sharman. 2014. *Global Shell Games: Experiments in Transnational Relations, Crime & Terrorism*. Cambridge: Cambridge University Press. www.globalshellgames.com.

Flemes, Daniel, ed. 2010. *Regional Leadership in the Global System*. Farnham: Ashgate.

Friman, H. Richard, ed. 2009. *Crime and the Global Political Economy*, IPE Yearbook #16. Boulder: LRP.

Goldstein, Andrea. 2017. *Multinational Companies from Emerging Economies*. London: Palgrave Macmillan.

Gray, Kevin, and Craig Murphy, eds. 2013. Special Issue: Rising Powers and the Future of Global Governance. *Third World Quarterly* 32 (2): 183–355.

Gu, Jing, Alex Shankland, and Alex Chenoy, eds. 2016. *The BRICS in International Development*. London: Palgrave Macmillan.

Haastrup, Toni, and Yong-Soo Eun, eds. 2014. *Regionalising Global Crises: The Financial Crisis & New Frontiers in Regional Governance*. London: Palgrave Macmillan.

Hale, Thomas, and David Held, eds. 2012. *Handbook of Transnational Governance*. Cambridge: Polity.

Hanson, Kobena T., ed. 2015. *Contemporary Regionalism in Africa*. Farnham: Ashgate.
Hanson, Kobena T., George Kararach, and Timothy M. Shaw, eds. 2012. *Rethinking Development Challenges for Public Policy: Insights from Contemporary Africa*. London: Palgrave Macmillan for ACBF.
Hanson, Kobena T., Cristina D'Alessandro, and Francis Owusu, eds. 2014. *Managing Africa's Natural Resources: Capacities for Development*. London: Palgrave Macmillan.
Hanson, Kobena T., Korbla P. Puplampu, and Timothy M. Shaw, eds. 2018. *From MDGs to SDGs: Rethinking African Development*. Abingdon: Routledge.
Harman, Sophie, and David Williams, eds. 2013. *Governing the World? Cases in Global Governance*. Abingdon: Routledge.
Harman, Stephen A. 2014. *Terror & Insurgency in the Sahara-Sahel Region*. Farnham: Ashgate.
Hartzenberg, Trudi, et al. 2012. *The Trilateral Free Trade Area: Towards a New African Integration Paradigm?* Stellenbosch: Tralac.
Henley, David. 2015. *Asia-Africa Development Divergence: A Question of Intent*. London: Zed.
Hicks, Celeste. 2015. *Africa's New Oil: Power, Pipelines & Future Fortunes*. London: Zed.
Hirschfield, Katherine. 2015. *Gangster States: Organised Crime, Kleptocracy & Political Collapse*. London: Palgrave Macmillan.
Hudson, Ian, Mark Hudson, and Mara Fridell. 2013. *Fair Trade, Sustainability & Social Change*. London: Palgrave Macmillan.
IDS. 2016. *Ten Frontier Technologies for International Development.* University of Sussex. November. www.ids.ac.uk.
IMF. 2016. *Regional Economic Outlook (REO) SSA: Time for a Policy Reset*? Washington, DC. April.
IMF. 2017. *Annual Report 2017: Promoting Inclusive Growth.* Washington, DC. October.
Jordaan, Eduard. 2003. The Concept of Middle Power in IR: Distinguishing Between Emerging and Traditional Middle Powers. *Politikon* 30 (2): 165–181. November.
Kabandula, Abigail, and Timothy M. Shaw. 2016. *African Multinational Forces in the Twenty-first Century: Challenges, Progress & the Future.* Paris. October.
Kararach, George, Hany Besada, and Timothy M. Shaw, eds. 2015. *Development in Africa: Refocusing the Lens After the MDGs*. Bristol: Policy Press. pb edition 2016.
Khanna, Parag. 2009. *The Second World: How Emerging Powers Are Redefining Global Competition in the Twenty-first Century*. New York: Random House.
Kobayashi, Kazushige. 2016. *Pax Integrationem? Exploring Institutional Responses to Regional Security Challenges,* Working Paper 2016/5. UNU-CRIS, Bruges, October.
Kshetri, Nir. 2013. *Cybercrime and Cybersecurity in the Global South*. London: Palgrave Macmillan.
Kyung-Sup, Chang, Ben Fine, and Linda Weiss, eds. 2012. *Developmental Politics in Transition: The Neoliberal Era and Beyond*. London: Palgrave Macmillan.

Laakso, Liisa, and Petri Hautaniemi, eds. 2014. *Diasporas, Development & Peacemaking in the Horn of Africa*. London: Zed for NAI.

Lansley, Stewart. 2016. *A Sharing Economy: How SWFs Can Reduce Inequality & Help Balance the Books*. Bristol: Policy Press Shorts Insights.

Lee, Bernice, et al. 2012. *Resources Futures*. London: Chatham House. December. www.chathamhouse.org/resourcesfutures.

Lesage, Dries, and Thijs Van de Graaf, eds. 2015. *Rising Powers & Multilateral Institutions*. London: Palgrave Macmillan.

Lorenz-Carl, Ulrike, and Martin Rempe, eds. 2013. *Mapping Agency: Comparing Regionalisms in Africa*. Farnham: Ashgate.

Mbabazi, Pamela K. 2013. *The Oil Industry in Uganda: A Blessing in Disguise or an All Too Familiar Curse?* 2012 Claude Ake Memorial Lecture. Uppsala: NAI. www.nai.diva-portal.org, www.isn.ethz.ch.

van der Merwe, Justin, Ian C. Taylor, and Alexandra Arkhangelskaya, eds. 2016. *Emerging Powers in Africa: A New Wave in the Relationship?* London: Palgrave Macmillan.

van der Merwe, Justin, et al., eds. 2017. *Emerging Powers in Africa*. London: Palgrave Macmillan.

Montoute, Annita. 2017. *Civil Society & Global Trade: The ACP Group & the EU*. Abingdon: Routledge, forthcoming.

Montoute, Annita, and Kudrat Virk, eds. 2017. *The ACP Group & the EU Development Partnership: Beyond the North-South Debate*. London: Palgrave Macmillan.

Moran, Michael. 2013. *Private Foundations & Development Partnerships: American Philanthropy & Global Development Agencies*. Abingdon: Routledge.

Morris, Jeremy, and Abel Polese, eds. 2015. *Informality & Governance in Post-Socialist Spaces: Practices, Institutions & Networks*. London: Palgrave Macmillan.

Mukherjee-Reed, Ananya, Darryl Reed, and Peter Utting, eds. 2012. *Regulation & Non-State Actors: Whose Standards, Whose Development?* Abingdon: Routledge for UNRISD.

Naylor, R.T. 2005. *Wages of Crime: Black Markets, Illegal Finance and the Underworld Economy.* Second ed. Ithaca: Cornell University Press.

Nel, Philip, and Detlef Nolte, eds. 2010. Regional Powers in a Changing Global Order. *Review of International Studies* 36(4): 877–974. October.

Nel, Philip, et al., eds. 2012. Special Issue: Regional Powers and Global Redistribution. *Global Society* 26 (3): 279–405.

Njogu, Kimani, and Seifudein Adem, eds. 2017. *Perspectives on Culture & Globalization: The Intellectual Legacy of Ali A Mazrui*. Nairobi: Twaweza Communications.

Nolke, Andreas, ed. 2014. *Multinational Corporations from Emerging Markets: State Capitalism 3.0*. London: Palgrave.

Noman, Akbar, and Joseph E. Stiglitz, eds. 2015. *Industrial Policy & Economic Transformation in Africa*. New York: Columbia University Press for IPD.

O'Neill, Jim. 2011. *The Growth Map: Economic Opportunity in the BRICs and Beyond*. New York: Portfolio/Penguin.

OECD. 2016. *African Economic Outlook 2016*. Paris. May. www.africaneconomicoutlook.org.

Peter, Mateja. 2014. *Emerging Powers & Peace Operations: An Agenda for Research*, NUPI Policy Brief #10. Oslo.

Pieterse, Jan Nederveen. 2011. Global Rebalancing: Crisis and the East-South Turn. *Development and Change* 42 (1): 22–48.

Robertson, Charles, and Michael Moran. 2013. Sorry, but Africa's Rise Is Real. *Foreign Policy.* January.

Roger, Charles, and Peter Dauvergne. 2016. The Rise of Transnational Governance as a Field of Study. *International Studies Review* 18: 415–437.

Rowden, Rick. 2016. Africa's Boom is over. *Foreign Policy*. January.

Shaw, Timothy M. 2015a. African Agency: Africa, South Africa & the BRICS. *International Politics* 52 (2): 255-268. January.

———. 2015b. African Development Post-2015: Sustainable Agency or Reversion to Dependency? In *Africa & the Age of Globalization: Perceptions, Misperceptions & Realities*, ed. Edward Shizha and Lamine Diallo, 33–48. Farnham: Ashgate.

———. 2015c. *From Post-BRICS Decade to Post-2015: Insights from Global Governance & Comparative Regionalisms*. Palgrave Communications. January 20. www.palgrave-journals.com/palcomms.

——— 2016. African Agency Post-2015: The Roles of Regional Powers & Developmental States in Regional Integration In *Region-Building in Africa*, eds. Levine and Nagar, 109–126. London: Palgrave Macmillan.

———. 2017. Transnational Africa(s): Ali Mazrui & Culture, Diaspora & Religion. In *Perspectives on Culture & Globalisation: The Intellectual Legacy of Ali A Mazrui*, ed. Kimani Njogu and Seifudein Adam, 37–63. Nairobi: Twaweza.

Shaw, Timothy M., J. Andrew Grant, and Scarlett Cornelissen, eds. 2011. *Ashgate Research Companion to Regionalisms*. Farnham: Ashgate.

Stuenkel, Oliver. 2016. *Post-Western World*. Cambridge: Polity.

Sumner, Andy, and Richard Mallett. 2012. *The Future of Foreign Aid*. London: Palgrave Macmillan.

Taylor, Ian. 2015. *Africa Rising? BRICS – Diversifying Dependence?* Martlesham: James Currey.

Tickner, Arlene B., and Ole Waever, eds. 2009. *International Scholarship Around the World: Worlding Beyond the West*. Abingdon: Routledge.

UNDP. 2013. *Human Development Report 2013: The Rise of the South: Human Progress in a Diverse World*. New York. March.

UNECA. 2012. *Economic Report on Africa 2012: Unleashing Africa's Potential as a Pole of Global Growth*. Addis Ababa.

USNIC. 2012. *Global Trends 2030: Alternative Worlds.* DC: National Intelligence Council. December. www.dni.gov/nic/globaltrends www.gt.com.

Vermeiren, Mattias. 2014. *Power & Imbalances in the Global Monetary System*. London: Palgrave Macmillan.
WACD. 2014. *Not Just in Transit: Drugs, the State & Society in West Africa*. Accra. June. www.wacommissionondrugs.org.
Warner, Jason, and Timothy M. Shaw, eds. 2018. *African Foreign Policy & International Organizations*. New York: Palgrave Macmillan. Forthcoming.
Weiss, Thomas G., and Rorden Wilkinson. 2014a. *International Organization & Global Governance*. Abingdon: Routledge.
———. 2014b. Global Governance to the Rescue: Saving International Relations? *Global Governance* 20 (1): 19–36.
World Bank. 2012. *Global Economic Prospects June 2012: Managing Growth in a Volatile World*. DC. June.
———. 2017. *WDR 2017: Governance & the Law*. Washington, DC, forthcoming.
World Economic Forum. 2012. *Global Risks 2012: An Initiative of the RRN*. Seventh ed. Davos.
www.jannederveenpieterse.com.
www.nonwesternworld.com.
www.risingpowersproject.com.
Xing, Li, ed. 2013. *China-Africa Relations in an Era of Great Transformation*. Farnham: Ashgate.

36

Urban Sustainability in India: Evolution, Challenges and Opportunities

Shrimoyee Bhattacharya

Background

The word "urban," as per the Census of India, refers to settlements with a minimum population of 5000, with a density of 400 persons per square km, and with at least 75 percent of the male working population engaged in non-agricultural activities. According to this definition, there are a total of 7935 urban settlements in India, which account for 31.2 percent of its total population (i.e., 377.1 million out of 1.2 billion) and 63 percent of its national economic output (Mishra 2015).

India has been urbanizing at a steady but moderate pace. The average annual growth rate of the urban population in India was 2.4 percent in 2015, which is lower than some of India's neighboring countries in South Asia, such as Bangladesh (3.4 percent) and Nepal (3.2 percent), but comparable to emerging global economies such as China (2.7 percent) (Urban Population Growth (Annual %) 2015). Despite having a lower share of urbanization compared to many developed and developing countries, India houses about 10 percent share of the world's urban population (Urban Population (India) 2015) and (Urban Population Growth (Annual %) 2015), and a few of the largest and most populated cities of the world. However, beyond the large cities, there exist a large number of small towns that constitute a substantial share of India's total urban population (Census of India 2011). Thus, the story of India's emerging urbanization is as much about its small, non-descript

S. Bhattacharya (✉)
Bangalore, India

R. Brinkmann, S. J. Garren (eds.), *The Palgrave Handbook of Sustainability*,
https://doi.org/10.1007/978-3-319-71389-2_36

towns spread across a large rural canvas, as much as it is about its large cities like Mumbai, Delhi, Kolkata, Bangalore, and Chennai.

Cities, by their very necessity, are supposed to be efficient by exploiting the flow of natural and human resources and information. Brendan O'Flaherty, in his book *City Economics*, argues that cities could persist, only if their advantages offset the disadvantages. The very notion of cities is of a space that is able to, through an exploitative role, provide a competitive advantage. Thus, there would be tensions between the ideas and practices of sustainability and the creation and use of urban spaces. One would therefore expect, from time to time, the emergence of questions and challenges regarding environmental, social, and economic justice. These questions become even more pronounced in places with severe environmental problems, especially remarkable in developing countries like India. The country has big stakes in its cities to achieve a high level of economic growth and, at the same time, is committed to global agendas such as the Sustainable Development Goals (SDGs), the New Urban Agenda of HABITAT-III, and the Paris Agreement on climate change.

In independent India's policy discourse post 1947, the formal recognition of urban as an important sector started with the eighth five-year plan (FYP), during 1992–97(refer Fig. 36.1). Until then, urban was dealt with through centrally driven programs, mainly focusing on basic infrastructure provision and the creation of a few new cities as capital towns. Urban sustainability, in its true sense, was not a conscious political discourse, yet. The 74th Constitutional Amendment Act (CAA), in 1993, paved the way for the empowerment of Urban Local Bodies (ULBs) to manage their own functions, including planning for their respective jurisdictions. Although the implementation of the 74th CAA in its true essence has been a debated subject in India, this landmark reform has actually been a catalyst for a number of flagship urban sector programs that Indian cities observed in later years. The Jawaharlal Nehru National Urban Renewal Mission (JnNURM) was among the first of such flagship programs. Despite various limitations, JnNURM managed to bring urban local governments to the center of dialogues while planning the cities' infrastructure requirements. References to sustainability, in the JnNURM, were mostly related to financial sustainability, at a time when private finance in public infrastructure creation was seen as a potential, in an otherwise dismal urban finance scenario.

The second generation of urban development programs were started post 2010. These programs (Smart Cities Mission, Atal Mission for Rejuvenation and Urban Transformation [AMRUT], Housing for All, Heritage City Development, and Augmentation Yojana [HRIDAY], among others), together,

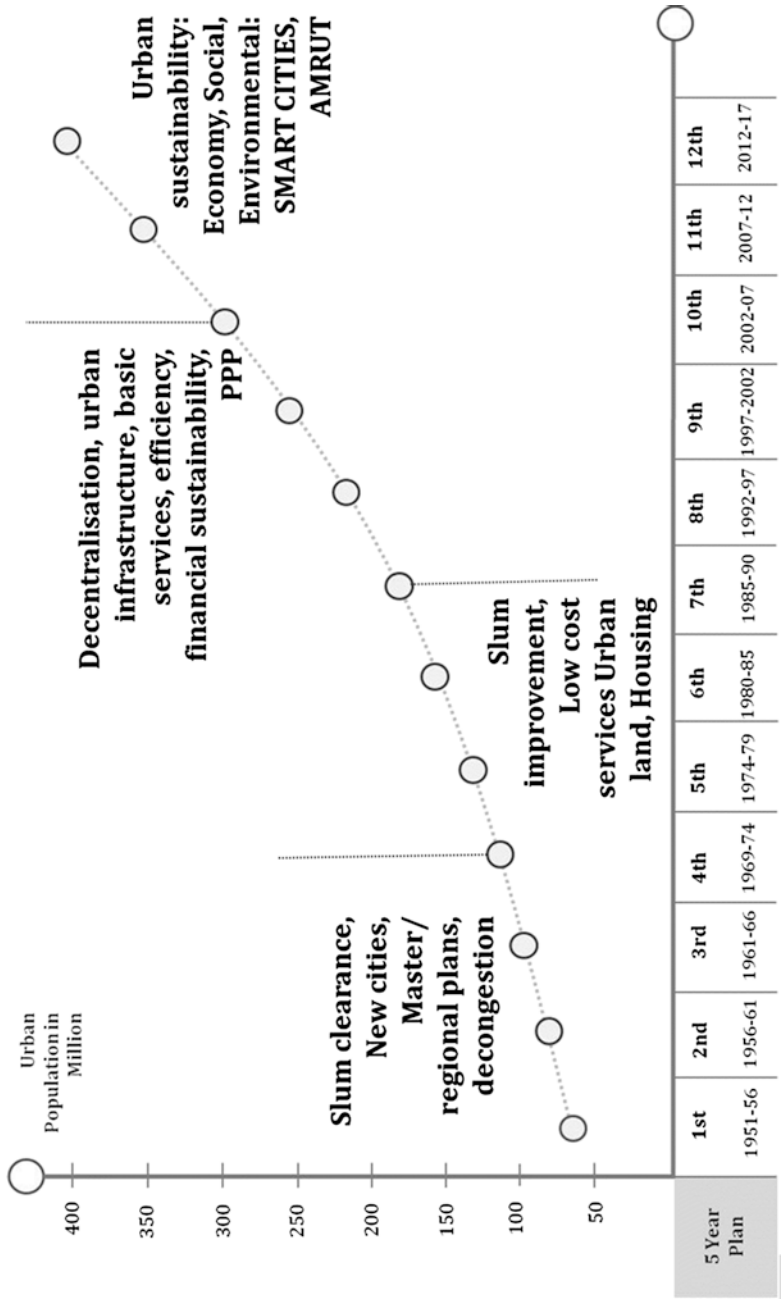


Fig. 36.1 Evolution of India's urban sector programs since 1951 (Source: Analysis done by the author from five-year plan documents released by erstwhile Planning Commission of India)

cover over 500 cities and urban settlements in India. Around this time, most of the mission statements and program guidelines had started mentioning "sustainability" as a goal, reflecting a more cautious approach in response to an intensified global agenda focusing on sustainability. However, these programs also reflected visibly different importance of diverse aspects of urban sustainability. Generally, one could observe more importance towards enhancing economic competitiveness of cities and financial sustainability of the ULBs.

Providing for the urban poor has always been a major focus of India's urban development programs which contributes towards the social equity pillar of sustainable development. However, the approach adopted for addressing the urban poor's conditions through urban development programs has been a contested issue with limited success on the ground.

Indian urbanization is constantly evolving at the intersection of growing population, changing economic and lifestyle pursuits, constrained resources, worsening environment, and a fast-evolving technology space. The status of Indian cities is a reflection of the interaction, as well as contestation among these forces, over space and time.

In the following sections, I present the emerging character of India's urbanization. This is followed by an overview of the performance of Indian cities, across a range of key quality of life and urban sustainability parameters, accompanied by anecdotes of sustainable initiatives that are slowly enabling change, on the ground, in Indian cities.

Case Study

India's Urbanization: A Spatial Phenomena Dominated by Large Cities and the Silent Emergence of Small Towns

Till the beginning of this century, Indian urbanization was primarily dominated and driven by million-plus cities, which also included three megacities with ten million-plus population in their urban agglomeration. The 2011 census results reaffirm the dominance of the million-plus cities (refer Fig. 36.2). However, what is emerging as a slightly different trend is the growth differential within different parts of large urban agglomerations (UA), and emergence of census towns as major shareholders (30 percent) in the total urban population. Between 2001 and 2011, population growth in core city areas under municipal jurisdictions has slowed down considerably. On the other hand, census towns and villages at the peripheries of the city and within the UA area,

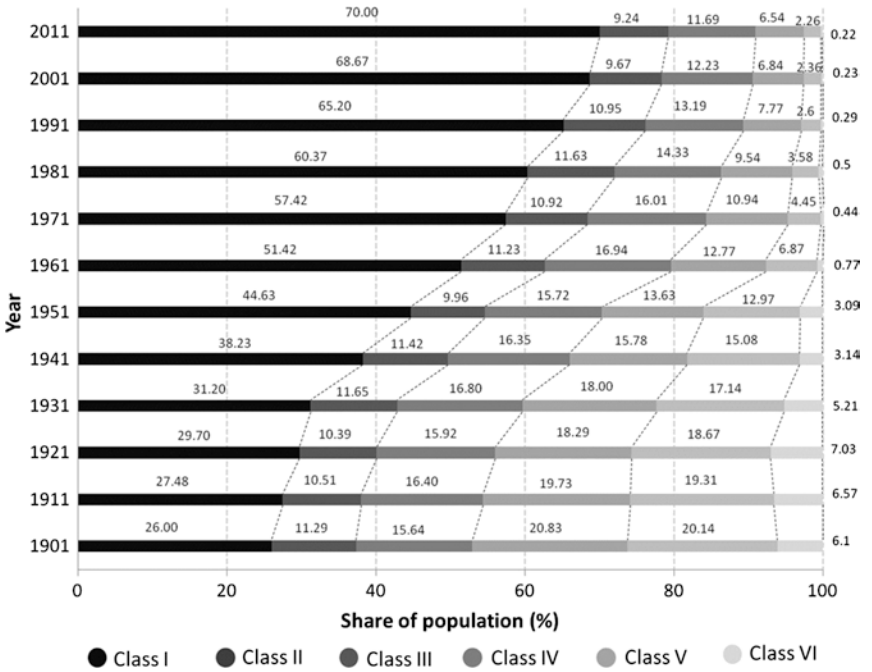


Fig. 36.2 Distribution of urban population across various size classes of towns in India (Source: Analysis done with data sourced from Census of India)

termed as Outgrowths, have experienced increased growth momentum. Greater Mumbai, the largest UA in India, has experienced a population decline in one of its urban districts in the core city area (Census of India 2011).

Another type of shift from rural to urban is silently taking place in some census towns located away from a large city and its immediate hinterland. These towns are experiencing rapid changes in economic activities, resulting in a spillover of urbanization into surrounding villages. A number of such towns play extremely important roles in the value chain of a global economy, but remain deprived of infrastructure and facilities comparable to their economic contribution. One important contributor to the emergence of smaller towns and their rapidly changing character is the development of industrial corridors running in long stretches across districts and states. Post 2011, at least five major industrial corridors have been conceptualized and are being developed in various parts of India. Integrated townships alongside these corridors have also been planned with the hope of creating new-age industrial settlements. However, such fully functional townships are yet to become a reality. On the other hand, land acquisition and redevelopment mechanisms have become important determinants for the success of such projects, many of which have seen severe disputes between landowners and various other stakeholder groups.

The remaining census towns which are neither periurban, nor display any significant economic activity, exhibit characteristics of villages where agriculture does not appear to be a viable option anymore. At this point, one should go back to the definition of urban in India, which does not include the status of infrastructure as one of the criteria. At the same time, notions of urban type of infrastructure continue to play a determining role in defining Outgrowths outside large cities[1] (Census of India 2011). This ambiguity is pronounced in new census towns which are devoid of adequate infrastructure and governance. The definition is also oblivious of the changing nature of rural outputs, which are becoming less and less dependent on agriculture (Mishra 2015), and the role of women in the economy.

In terms of spatial distribution, the southern states of India, and some of the northern and eastern states show higher levels of urbanization. In most of the states that have noted a high urban population growth rate during the decade 2001–11, a large number of new census towns have contributed to the rate of urbanization (Bhagat 2011). Also higher urbanization in states could also be correlated to higher levels of economic advancement.

Sustainability and Indian Cities: An Historical Legacy of Urban Form and Function

Sustainability of cities is in many ways a function of sustainable urban lifestyles. The culture the Indian subcontinent has been of making more with less. Though changing rapidly with the rise of an affluent Indian middle class, the frugal legacy still puts Indians ahead of most other countries in environmentally sustainable consumption.[2] India, as well as much of South Asia, has traditionally followed a more resource efficient trajectory. The region has always had the challenge of meeting expectations of a large population base with limited land and other geological resources. Indian cities had grown as mixed-use dense settlements promoting walkability, lesser motorized trip length, and safer and vibrant public spaces. Traditional Indian neighborhoods had followed design principles that optimized the use of space, sunlight, and coping mechanisms against adverse climatic conditions, by using vernacular construction materials and urban planning principles (Sanyal et al. 2010). For instance, ancient cities of the Indus Valley contained urban centers and appear to have been well-planned with organized infrastructure, architecture, and systems of governance.

Judicious and planned use of life-sustaining natural resources such as water has been an integral part of traditional Indian urban settlements as could be seen from *Kere*s (lakes) in southern Indian states to *Bauli*s (stepwells) in northern and western parts of the country. The vibrancy and variety in Indian cities as centers of activity are difficult to match.

India as a country and its cities continue to maintain a lower per capita consumption of resources. India has a smaller ecological footprint (EF) compared to countries of similar size in terms of population and economy. Considering that the urban sector contributes to more than 60 percent of the national economy, India's urban areas are more resource efficient than most of its developed country counterparts. However, this aspect of urban sustainability of modern Indian cities is partially a result of suboptimal quality of life standards. The following sections transect India's present urban centers for their sustainability in some key quality of life indicators set against four key sustainability principles.

Apart from a summary of performance of cities, this chapter highlights some positive changes that are taking place mostly driven by a more engaged citizenry and civil society. These positive stories are yet to scale and are mostly exceptions rather than the rule. However, these are the lighthouses for driving India's urban story towards a more sustainable pathway.

Sustainability of Twenty-First-Century Indian Cities: The Emerging Picture

The measurements of urban sustainability are built around the three pillars of sustainable development (i.e., social equity, ecological conservation, and economic growth). More recently, few city sustainability indices have represented these three pillars under people, planet, and profit, inspired by the Sustainable Development Goals (SDGs).

This chapter assesses sustainability of India's urbanization anchored by four key principles emerging from the SDGs: well-being, equity, efficiency, and foresight (or resilience) (Bhattacharya et al. 2015). The discussions in the following sections reflect the status of all three pillars of sustainability in terms of their outcome, and not necessarily the intent of various interventions the cities have been subjected to. The data to discuss sustainability have been sourced from a variety of studies done by different institutions and thus not necessarily synchronized over space and time. However, this chapter attempts to include data for major cities in India along comparable timelines.

Well-Being and Equity Through the Lens of Urban Quality of Life in India

Well-being of a city could be summarized as the average quality of life of its citizens. Expression of citizen rights in a city in a given political framework could also indicate well-being of a city. However, the general impression could camouflage exceptions and outliers that also co-exist in a city system that provide critical insights in understanding of urban equity. In other words, a well-being status against a certain parameter is not necessarily a reflection of distribution of the same across various social and geographic locations. The latter requires disaggregated analysis of data, and many times, in the absence of the data, anecdotes provide valuable proxies. This section discusses urban India's performance in quality of air and water and access to critical urban services, both in terms of average numbers and through a dipstick or snapshot assessment of the status of those who are less privileged.

Quality of Urban Environment: Air and Water

In 2014, 37 Indian cities appeared in the list of top 100 polluted cities in the world published by the World Health Organization (WHO). According to the National Air Quality Monitoring Index (NAQI) which monitors 43 cities across India, under the National Air Quality Monitoring Program (NAQMP), a large number of the Indian cities did not meet India's National Air Quality (NAQ) norms during 2015–16, despite the latter setting a higher limit compared to WHO standards ("NAQI status of Indian cities" 2015). A recent study indicated that pollution levels across all 168 cities monitored under the study (including the NAQMP cities) are above the WHO standards. The report also suggests that air pollution causes 1.2 million deaths in India annually and costs the economy about three percent of the national ("Airpocalypse: Assessment of Air Pollution in Indian Cities." 2017). One could say that a large share of this life and economic loss is contributed and borne by cities in India. Those most vulnerable to impacts of air pollution include populations that are the most exposed to large amounts of air pollutants. These include those living along roadsides and spending long hours outdoors ("Air Pollution Nitrogen Dioxide," n.d.). This also includes homeless populations in cities, a large number of whom are migrant laborers. The

transport sector is one of the major contributors to air pollution in Indian cities (13–22 percent).

Water quality in Indian cities has two separate dimensions: quality of supplied water and the quality of both surface and groundwater in the natural urban ecosystems. The former is not always a shadow of the latter as many Indian cities such as Bangalore source large volumes of water from distant sources for supply within the city. According to the Central Pollution Control Board (CPCB), in India, most of the rivers passing through or close to cities are polluted heavily in the downstream due to large-scale water abstraction and discharge of untreated or partially treated industrial effluents and sewerage (Aggarwal 2016). The Ganga, one of the most urbanized and largest river basins in India, is also one of the world's most polluted rivers, with 17 cities located, respectively, on its banks ("Pollution Assessment: River Ganga" 2013).

Drinking water demand, for many cities in India, is met by groundwater. According to a CPCB report published in 2011, which studied 28 cities across India, most of the cities have been found to have groundwater quality issues such as being contaminated with sewerage water, unchecked extraction, reduction in groundwater recharge due to increased built-up areas, and concentration of some minerals beyond permissible limits ("Ground Water Scenario in Major Cities of India" 2011).

While access to drinking water in urban India has improved considerably, the quality of drinking water supplied by civic authorities is a concern for citizens. A small study in a poor urban pocket in Delhi, in 2013, revealed that about 42 percent of households were receiving contaminated water. As a consequence, 24 percent of children suffered from diarrhea, and 11 percent of households experienced death of an infant (Varma 2014). Overall, there are signs that the quality of drinking water in cities, from all sources, suffers from water quality problems, with the urban poor mostly bearing the brunt, through loss of working days and sometimes life.

Two large-scale government programs to restore the glory of India's two mightiest rivers—the Ganges and the Brahmaputra—have been initiated by the government of India. Happening in parallel is a community initiative to clean the Adyar River, passing through the city of Chennai, and make it free of pollution received from the city. The initiative also included greening of some of the islands on the river.

Access to Services: Housing

The housing situation in Indian cities can be described as predominantly being a demand-supply problem. There is both under-supply and over-supply, depending on housing for different income groups. According to the Technical Group on Urban Housing Shortage 2012–17, there was a shortage of 18.78 million houses in urban India in 2012. Out of this, about 96 percent (18 million) of the shortage was in the low-income group (LIG) and economically weaker sections (EWS), whereas 80 percent (15 million) of this shortage was constituted by means of congested houses. Here, one should note a quick comparison with the slum population in India which is 13.7 million, according to the Census of India 2011.

In this context, it is important to look at the issue of urban equity with respect to Indian slums, which often represent as bleak areas of deprivation. Even though the inadequacy of shelter and the incidence of poverty are not confined to slums only, these pockets undoubtedly exhibit sub-standard quality of life conditions. However, the mere presence of slums cannot be the sole statement of urban inequity. First, there is little agreement on what could be labeled as a slum, and there are political economy considerations behind these decisions. There are poor urban pockets under severe distress that might not be included in official slum figures because of reasons, such as the legal status of the land occupied by them. Second, slums could be, arguably, an indication of more inclusive cities in a given geo-political context where cities do not close their doors to migrants and refugees. In such cases, slums emerge as a result of an inadequate system to cater to the demands of these inhabitants seeking a place in the large city. However, there are serious issues relating to distribution of wealth, infrastructure, and natural resources, and thus, slums do present the most interesting case to be studied while discussing urban equity.

Access to Services: Transport

Indian mega cities score low compared to their global and Asian counterparts in the walkability index ("Walkability in Indian Cities" 2011). Between 1951 and 2011, the share of buses among total motor vehicles has come down from 11 percent to 1.1 percent ("Review of Urban Transport in India" 2014). Out of 468 cities with more than 1 lakh population, only 61 cities have a formal bus transport system (Gadepalli 2016). Among the mega cities, only Mumbai

and Kolkata have full-fledged suburban rail systems connecting different parts of the city. It is estimated that in several megacities in India such as Delhi, Mumbai, Kolkata, and Bangalore, buses which are generally one to two percent of the total number of vehicles on the road are used to meet 33–62 percent of the total vehicular trip demand. Importantly, non-motorized transports (NMT), especially walking, constitutes a substantial portion of total mode share (48–55 percent) in Indian cities. However, this does not necessarily indicate good walkability conditions in cities, and merely demonstrates a compulsion of commuters with less access to affordable public transport.

With more private vehicles, traffic congestion in Indian cities is a concern that is catching global attention and is proving to be detrimental to competitiveness of Indian cities as investment destinations. Studies show that in most Indian cities, both large and small, travel speeds are slower than in cities like Singapore, London, Melbourne, and Sydney. ("Review of Urban Transport in India" 2014)

"Whitefield Rising" is a platform for citizens living in an upcoming locality, one of the information technology hubs in Bangalore. It is trying to make a change in the civic infrastructure and services situation in their locality (such as condition of roads, footpaths, water, and sanitation) by focused group discussions, seeking expert help, interacting with the government/municipal bodies, and implementing solutions.

Access to Services: Water and Sanitation

According to the Joint Monitoring Program 2015 Report for the Millennium Development Goals (MDGs), most South Asian countries, including India, made substantial progress towards increasing access to drinking water and sanitation facilities. According to the World Bank statistics, about 97 percent of the urban population in India had access to improved sources of water, and about 63 percent had improved sanitation facilities in 2015. These figures indicate an increase of about four percent and eight percent from 2001, respectively, for water and sanitation sector. However, several other studies have indicated a more moderate access situation for these two critical basic services in urban India while acknowledging the enhanced policy focus in the national domain. Access for urban poor remains lower than national averages (refer to Fig. 36.3).

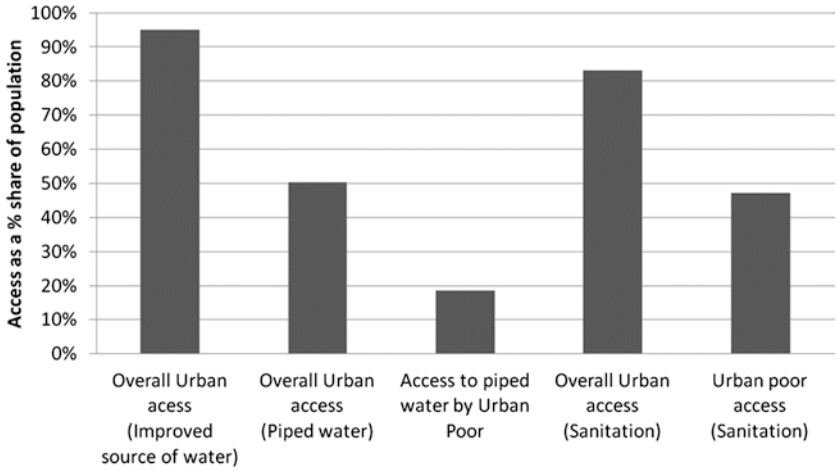


Fig. 36.3 A summary picture of urban India's access to water and sanitation (Source: Analysis done by the author from Water Sanitation Scenario in Urban India document, by the Health of the Urban Poor (HUP) Program and Population Foundation of India, submitted to the UN India Water Development Report 2012)

The statistics however leaves scope for scrutiny in terms of the access conditions they indicate, as well as the quality of the facility to which citizens have access. For example, the census of India measures access in terms of physical distance of the facility for households. However, it does not capture aspects such as reliability, time, location, and design of the facility, which can render a facility inaccessible despite being located within the normative physical distance. Moreover, since most of the burden of water provision for households is on women, and women are the group which suffers most due to absence of sanitation facilities, lack of proper access conditions has significant impact on women, resulting in more hours of unpaid care work, loss of economic opportunities, and sometimes exposure to violence (Bhattacharya et al. 2016).

Public toilets in Trichy, a tier-II city in the state of Tamil Nadu in India, are being managed by women self-help groups (SHGs) with support from a number of donors and NGOs. Apart from positively impacting health indicators in the city, with more sustainable financial returns compared to ULB-managed toilets, the project has been an example of social empowerment, especially for women.

Efficiency

The word efficiency can have different connotations when described in relation to cities. Most commonly, it is used in connection with production of economic value vis-a-vis use of resources, or efficiency of urban services, in terms of leakage and unaccounted losses. In this section I examine efficiency from three broad perspectives: one, as a wider function of ecological systems within which cities sustain themselves, that is, its use of resources vis-a-vis its availability expressed by ecological footprint (EF); two, functional efficiency of urban service delivery; and three, economic sustainability of urban local bodies.

Ecological Footprint of India's Urbanization

At a country level, India accounts for approximately 7.1 percent of the global total EF and 4.9 percent of world's total bio-capacity ("Species and Spaces, People and Places" 2014). India's EF is the third largest in the world after the USA and China. However, India has historically had a lower per capita EF (ranked 135 globally with 0.9 global Ha/cap) compared to developed countries; it is also lower than countries with comparable economies and population size, such as China (approximately 2.2 global Ha/cap), as per 2002 data. However, there is an increasing gap between per capita EF and available bio-capacity of India. Notably, built-up areas contribute to six percent of the total ecological footprint of India ("Species and Spaces, People and Places" 2014)

While there is no reliable assessment of EF of Indian cities, which is considered as a good comprehensive measure to assess ecological sustainability, studies for other cities show that generally, a compact city form with higher population density could be directly related to lower EF.[3] However, looking beyond per capita numbers, the larger picture raises tough questions for overall ecological consequences that India's urbanization is creating, given its bio-capacity.

There is increasing evidence that rapid urbanization of cities in India has not only resulted in significant change in land use but also negatively impacted natural ecosystem and biodiversity ("Impact of Urbanisation on Biodiversity" 2012). It is estimated that the average EF of India's urban middle class would increase in the long run, owing to growth in population and consumption (Rajashekariah 2014).

In the absence of a comparable statistics on EF of Indian cities in recent times, we look at some specific parameters that contribute to overall ecological footprint of cities and, thus, can give an idea about the trajectory in which

cities are growing, or rather what sort of ecological and environmental compromises and consequences they are creating, both within and outside the physical urban jurisdictions.

Souring Water for Urban India

Almost all the megacities and many of tier-I and tier-II cities have started facing water crisis especially during hotter seasons. The demand-supply gap ranges anywhere between 70 percent and 17 percent (Dash 2013). A number of large Indian cities meet their water demand from sources located far away. This creates sustainability issues on multiple fronts. First, sourcing water from far distance is generally accompanied by high transmission and distribution losses as well as high cost of transportation and high consumption of energy. Second, dependency on faraway sources is subject to high external variables and thus become unreliable in the long term. Third, it raises a larger question of social equity and environmental justice regarding the distribution of life-sustaining natural resources. Fourth, sourcing water from faraway sources has been related to a more complex behavioral aspect of both citizens and civic agencies that start neglecting nearby water bodies, which are no longer used as sources of water for the city and its citizens. Cities that use their own groundwater are fast depleting their dynamic water reserve as groundwater extraction is far higher than its recharge, as a result of blocked drainage channels and decreases in permeable surfaces. A report prepared by Mihir Shah, former member of the erstwhile Planning Commission of India and an eminent expert on urban water systems, noted that as cities grow, engulfing peripheral areas into their municipal boundaries, and become denser, their dependence on external sources of water grows, along with increased inequality of supply and poor infrastructure conditions in the peripheries (Shah 2016).

A gated residential community towards southeastern part of Bangalore has managed to achieve water sustainability for its own needs using the Integrated Urban Water Management approach.

The 800-year-old Nizamuddin Baoli, the only surviving stepwell in Delhi, was restored by an NGO that worked closely with the community. The project included creation of parks and open spaces, especially for women and children. In fact, at the time of writing this chapter, Vijayapura, an ancient city in southern India, has started drawing water from its ancient *Bawadis* (huge open wells) built during the fifteenth to seventeenth century after successful restoration.

Managing Waste from Urban India

Waste, both municipal solid waste (MSW) and solid and liquid waste from the city's sanitation, are not only important aspects in maintaining a city's aesthetics and liveability but can also lead to grave consequences for the well-being of citizens, the peri-urban areas, and the larger ecological systems surrounding the city. The average per capita MSW generated from Indian cities ranges anywhere between 0.36 and 0.55 kg per day; the bigger the city size, the higher the number. This is in general lower than cities in the developed countries, owing to the average Indian lifestyle which has lower consumption levels compared to developed countries. Evidence shows that collection efficiency of MSW in some of the Indian cities could be as low as 20 percent and as high as 100 percent. However, the major problem lies in handling of solid waste after collection. Most of the cities rely on landfills to dispose MSW, and most of the time these landfill sites are located outside the city. While landfills do pose a serious threat of polluting local ecosystems, especially water resources, studies show that landfills are going to be unsustainable in the long run owing to the area of land needed to accommodate the amount of waste generated from an increasing urban population, in an increasingly landlocked urban future. Considering that only a minimal share of MSW is treated (about 13 percent as estimated in 2011) and an even smaller amount is recycled for reuse, it also contributes to the increasing EF of cities (Joshi et al. 2016).

Fecal sludge management (FSM) is another aspect that has been posing challenges to health and well-being in cities and degrading the larger environment and ecosystem, especially water systems. It also affects various aspects of human development, especially with different marginalized groups in cities facing varying types and degrees of vulnerability. A Fecal Sludge (FS) Flow diagram, constructed for Indian cities, shows that about 81 percent of FS goes untreated and is directly disposed (Rohilla et al. 2016). This further pollutes water bodies and river systems carrying traces of pollutants downstream far beyond city limits. Vrishabhavathy, an ancient river originating right from the center of the city of Bangalore, has turned into a drain loaded with untreated sewage, toxic chemicals from industries, and garbage. Many of the rivers passing through cities eventually meet a similar fate. They emerge again, reminding citizens and civic authorities about their otherwise forgotten might and intrinsically nested relation with the city, only during the time of urban floods.

Notably, India has spent approximately USD 5000 million, for the Ganga Action Plan (GAP), over the last few decades, to restore one of its largest rivers, the Ganges, to its past glory, by cleansing the waste flowing through its

water. However, in the absence of a robust planning and mechanism for controlling the sources of waste, much of what is contributed by the city's sewerage systems and industrial waste, the GAP has remained largely ineffective.

A wetland towards east of the city of Kolkata sprawls over 125 sq. km. and receives about 1000 mld of sewerage from the city. The wetland, part of which is used for fish cultivation and provides livelihood to thousands of farmers and fishermen, treats the sewerage completely organically without any cost to the city government. Having the status of a Ramsar sites, one of the 26 such in India, the wetland however has not escaped threats of encroachments from the fast growing real estate industry—an increasing concern.

A number of citizen-led initiatives to restore lakes in Bangalore, the once coveted garden city of India, have started gaining momentum and are showing results on the ground. These initiatives are pushing civic authorities to take action to restore the man-made lake system of Bangalore, which has diminished from 262 lakes in 1960 to only 81 in 2017.

Energy Demand and Emissions

India is projected to be the largest contributor to the rise in global energy demand by 2040, although the projected per capita demand would still be 40 percent lower than the world average ("India Energy Outlook (World Energy Outlook Special Report)" 2015). A major share of this demand will be from Indian cities. Currently, about one quarter of the energy demand in India is met by renewable sources—the rest is met by fossil fuels. Considering that India is just entering into a more industrialized and urbanized future, the energy demand from cities is likely to grow substantially. Nevertheless, the country is committed to reducing the energy intensity of its economy by 20–25 percent by 2020, and thus new and renewable sources of energy are receiving increased policy focus.

Literature suggests that most of India's emissions will come from its urban agglomerations, negatively impacting the environment and its rural population (Sanyal et al. 2010). In 2015, a study published by the Indian Institute of Sciences presented a sector-wise assessment of carbon footprints of seven major cities in India (Fig. 36.4).

Transportation and domestic sectors were found to be the two biggest contributors of emissions in these cities.

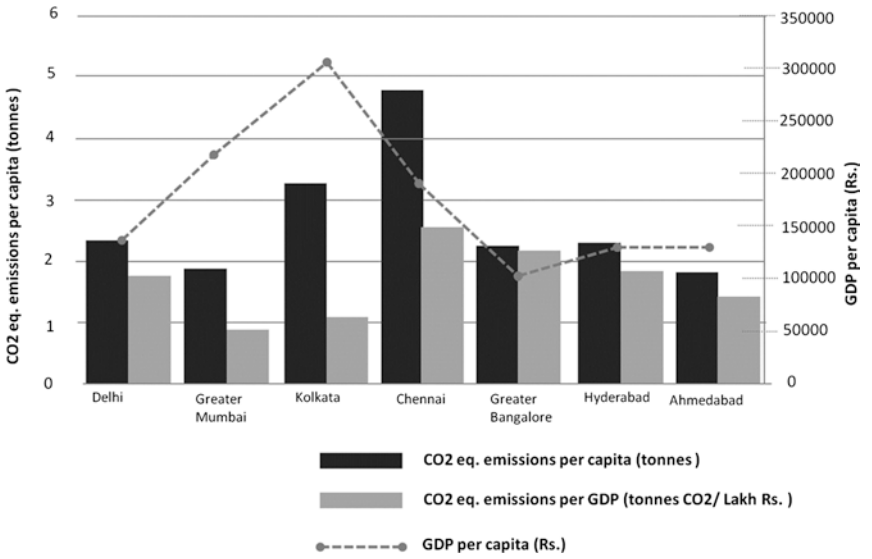


Fig. 36.4 CO2 eq. emissions per capita, GDP per capita, and CO2 equivalent emissions per unit of GDP for different cities (Ramachandra et al. 2014)

Electric Vehicles (EV) for Indian Cities

India's National Urban Transport Policy has set forward-looking policy directions by advocating for land-use and transport integration, emphasizing on moving people rather than vehicles, and also pushed cities to think about EV as the viable mode of clean and efficient public and private transport. A number of Indian states (such as Himachal Pradesh) and cities (such as Bengaluru) have carried viability studies of EV as an option and started procurement of vehicles.

Efficiency of Urban Service Delivery

An important aspect of efficient urban service delivery lies in non-revenue services. While a portion of this could be attributed to transmission and distribution (T&D) losses, a large part could also be due to non-collection of charges for services provided. While the first is largely due to quality of infrastructure and technical matters, the latter is a direct function of the efficiency of urban governance mechanisms.

Nonetheless, it is interesting that a large amount of non-revenue water (NRW), besides the T&D loss, actually caters to sections of the population who otherwise are not included in the formal service delivery net, such as migrant laborers working in informal sectors. The informal sector in India absorbs about 70 percent of the urban working population, with an average annual growth rate (4 percent) higher than the formal economy (2.5 percent). It would be

interesting to estimate the economic gain generated by this informal economy, which benefits from NRW, as opposed to the loss incurred on account of the same. Another argument is that a large part of the T&D loss actually goes back to the ecosystem through groundwater recharge, although not in the most efficient manner. Many Indian cities have been aiming for 24×7 water supply for which minimizing T&D loss is a prerequisite.

About 30 percent of the total water drawn from the Cauvery River for Karnataka is lost in transmission, and about 20 percent of total water supplied to the city of Bangalore is accounted as NRW. On the other hand, some reports suggest that the 24×7 water supply scheme in the city of Nagpur, one of the first ever in India implemented through public-private partnership mode, is actually turning to be more inequitable to different localities and sections of citizens.

Economic Efficiency of Urban Local Governments

Urban India contributes approximately 60 percent to the national economy (in gross domestic product terms). However, there exists a substantial backlog in basic urban infrastructure provisions, which is estimated to be around USD 250 billion as per the estimates of the High Powered Expert Committee on urban infrastructure. This implies that more investment is needed from public and private sources.

Self-sustainability of ULBs continues to be a challenge even with increased interest from the private sector to engage with cities, by means of investment and expertise. A number of assets and infrastructure built with private sector assistance or even through support from state or central governments are turning out to be dead investments in the long run, as the ULBs are not able to sustain financial sources for operation and maintenance of the assets. A credit rating of Indian cities published in 2017 reveals that only 94 out of 500 cities included in the Smart Cities Mission and AMRUT have obtained ratings, which is necessary for securing different modes of financial self-reliance such as the issuance of municipal bonds ("Press Information Bureau Government of India Ministry of Urban Development" 2017).

In 2016, the citizens and civil society of Bhopal, a tier-II city in India, managed to create enough pressure on the local government to put on hold the plan for a high-end area development plan and instead initiate actions towards preparing a strategic plan for integrating the city's natural elements into the urban development process. Around the same time, civil society-led protests compelled civic authorities in Bengaluru to drop a high-investment flyover construction plan, which was not a viable solution for the city's traffic problems. Following the success of this movement, civil society groups have launched an online platform named *Niga* (vigil) to enable the citizens and communities be vigilant over decisions made by civic authorities.

Resilience

Resilience in urban systems can be described as a combination of foresight and coping mechanisms. In their fifth assessment report, the Intergovernmental Panel on Climate Change (IPCC) has mentioned six major categories of climate change threats to cities and urban areas, which are drought, increased precipitation, rising sea levels and storm surges, inland and coastal flooding, heat stress, increased aridity, water scarcity, and air pollution (Revi et al. 2014). South Asia is regarded as one of the most vulnerable regions to impacts of climate change. Evidence shows that South Asian countries, including India, are more prone to natural disasters compared to the rest of the world.[4] The vulnerability of these areas is compounded by the region's low human and economic development indices compared to developed countries. Cities, which signify concentration of population and economy, naturally incur substantial loss of human and economic resources. Indian cities, some of which are among the most populated ones in the world, tend to show vulnerability especially in the wake of extreme natural events such as heavy precipitations, resulting into urban floods, which are becoming more frequent. India figures among top five countries in Asia and the Pacific in economic damage and fatalities ranking with significant impact of disasters in urban areas. Naturally, building urban resilience is emerging as one of the top priorities of the region. Incidents of urban flooding in the recent past in Indian megacities, such as Mumbai and Chennai, expose significant fault lines in the city's spatial growth management strategies and disaster response mechanisms. Urban floods in Chennai, caused by heavy rainfall, over short periods of time in November 2015, were estimated to have led to losses worth USD 2.2 billion, apart from loss of lives. While one cannot control natural events, the reason behind such severe impacts of the floods was largely anthropogenic. One common feature that could be seen in almost all urban flooding incidents in India is unscientific spatial planning of built infrastructure and lack of enforcement of laws. In all cases, built spaces encroached upon prime natural contours or were chocked by garbage. While innovative disaster assessment techniques and data gathering tools are increasingly being used, such cutting-edge efforts are yet to be largely mainstreamed in formal city governance mechanisms.

Chennai was better prepared after the 2015 floods by taking proactive measures to create a stronger flood monitoring and response mechanism.

There are a number of indigenous flood modeling efforts done by national- and state-level disaster management authorities and premier technology institutes in India which are better designed to capture contextual variations of cities in India.

Lessons Learned

Indian cities continue to create paradoxical examples of inclusion through informality[5] and efficiency through rather compromised quality of life standards. As economic output of urbanization increases, we see tougher contestations in cities and their adjoining peri-urban areas, over questions of well-being, equity, efficiency, and resilience. The contestations take different forms depending on power structures such as citizen vs. citizen, citizen vs. business groups, or citizens vs. government. A part of the struggles for efficiency and equity seen in Indian cities is inherent to the fact that India is stressed for natural landmass resources compared to its large population. Nevertheless, at the same time, these struggles and tensions could be perceived as a feature of the ongoing urbanizing trajectory that Indian cities are experiencing. Thus, it would be inadequate to apply lessons from more urbanized contexts and expect them to work. Western cities experienced peak urbanization when there was no internet and when the world did not start to stare at a 2° C global temperature rise scenario. India and other south Asian cities are currently in an unusual phase in an atypical period which demands unique and carefully crafted strategies and responses. We are also at a stage wherein the characteristics of future Indian cities are not easy to predict. They may develop along their current trajectories or result in alternative urban paradigms that embrace ecosystems limiting traditional growth, or perhaps along some other path.

Going back in time, the idea of collaborating with nature can be seen in most ancient Indian cities, until engineering skills and investments started overpowering natural constraints. Modernization has put Indian cities on the global map in an increasingly open economic paradigm but at the same time brought consequences that urban governance mechanisms were not prepared for. At this juncture, a new genre of initiatives focusing on cities has come forth with the hope of transforming India's urban face.

India's urban development started receiving focus not very long ago. There is visible effort in measuring outcomes instead of outputs along with a slow shift in perspective of what we consider as symbols of prosperity. More importantly, a more concerned and better-informed discourse is slowly gathering momentum emphasizing a more holistic approach towards planning for ecosystem-based services which can create a viable win-win model in the long run.

One must also remember that at present, India's megacities highly influence average numbers because of the sheer number of the population that resides in them. However, megacities are reaching their carrying capacity fast.

Thus, the future urban population of India, which is projected to double by 2050, will mostly reside in tier-II and tier-III cities. In tier-II and tier-III cities, the problems have not reached a complex stage as much as they have in megacities, which appear to be resistant to solutions. There is an urgent need to focus on these cities, and intense research is needed on census towns, peri-urban areas, and their transformations.

Despite unsatisfactory average performance, Indian cities exhibit tremendous coping mechanisms to sustainability challenges. The future lies in learning from anecdotes and finding the right entry point in the established institutional mechanisms to scale up successes. India's demographic position is to its advantage with the age-pyramid bulging below the 20 years age group and thus ensuring a continuing work participation over the next three to four decades. India also has a more stable domestic environment congenial to stable economic growth compared to many of its South Asian counterparts. We also see the emerging of an increasingly aware and concerned citizenry that is turning the otherwise theoretical discourse of sustainable development to more real-life, tangible actions. The future looks somewhat hopeful.

Challenges and Barriers

Sustainability is not an easy or simple goal, especially in developing countries that are sharing the responsibility of reducing global carbon footprint while being positioned far below their developed country counterparts in prosperity and quality of life standards. Continuous contestations in urban spaces show the struggle to seek justice in the face of conflicting goals that are handled through hurried responses. Formidable challenges exist in a number of areas, and these ought to serve as a guide in the formulation of the next phase of urban development programs in India.

- *Scalability and Replicability*: India is a large and diverse country with many agro-ecological zones and different social and political forces at play in different parts of the country. Nevertheless, replication and scaling up are a must, and this needs learning from both success and failure. Indian cities also need to learn better from each other and from developing countries in similar contexts, before looking for solutions from Western countries. There exist smaller stories of success, which show immense possibility. The key is in collective effort and an efficient governance mechanism supporting the same.

- *Data Preparedness and the Problem of Evidence-based Policy-Making*: India, like many other developing countries, suffers from poor data syndrome. Meaningful data is key to transitioning from an output-oriented discourse to a more outcome-oriented discourse. Lack of disaggregated evidence also limits opportunities that could emerge by comparing intersections of different sectors. Synchronization between sectoral programs under various ministries, in data, scale, time, and fiscal management, is critical to achieving a universal agenda like sustainable urban development. The hope is that India's commitment towards the SDGs will galvanize actions towards this, a substantial part of which is expected to be crowd-sourced with critical involvement of civil society and think tanks.
- *Capacity of Urban Institutions Affecting Good Governance Agenda*: There is substantial capacity constraint, especially at ULBs level to carry out reform agendas, especially the e-governance schemes and to respond to growing demand from increasingly aware citizenry. The fast-changing technology space is generating additional requirement for adequate training and capacity building in ULBs and across urban sector institutions. While the new-age programs focused significantly on citizen engagement, translating the same into an effective coalition of actors for the city's benefit has not been possible through these programs. It is interesting that approaches (such as various open data initiatives) are coming into existence outside the ambit of formal programs and gathering enough weight to influence decision-making.
- *Thinking Beyond Cities and Linking Villages to Sustainable Urbanization*: Cities, in order to be true engines of growth, need to lead to the development of a region. Little evidence exists on livelihood generation by cities beyond the formal sectors. A substantial gap remains in the understanding of peri-urban dynamics and how these areas in transition relate to the city, the inflow-outflow pattern in terms of natural resources, economic opportunities, migration, and vulnerability. The urban-peri-urban-rural relationship is stronger than what is recognized in present urban governance mechanisms. Cities are living off their fringes and the rural areas both adjacent and away from them. It is high time that the capacity of rural local bodies be given as much importance while advocating for capacity building of urban local bodies, especially in rapidly urbanizing contexts.

Finally, the importance of asking the right question and creating conversations around sustainability issues cannot be undermined as cities embrace technology-driven solutions and operate on tools and platforms. Fundamental and exploratory research, with multi-disciplinary approaches, can lead to

enhanced understanding of the pattern of urbanization in India and related sustainability issues. There is little disagreement that the future generation of urban and rural sector programs need to be built on a much better understanding of urban dynamics in order to convincingly argue for cities as engines of growth.

Notes

1. OGs—outgrowths are defined as enumeration blocks with viable boundaries, such as villages, which are physically contiguous to a town and possesses urban features in terms of infrastructure and amenities.
2. According to 2014 National Geographic/GlobeScan Consumer Greendex which is a scientifically derived sustainable consumption index of actual consumer behavior and material lifestyles across 18 countries, Indians are the top-scoring environmentally sustainable consumers.
3. Studies measuring ecological footprint of Atlanta, Dubai, Vancouver, Berlin, Dubai, London, and Barcelona show that Atlanta and Dubai have the highest EF compared to other five cities, which either have a compact urban form or high population density or both. Refer to http://assets.wwfindia.org/downloads/urbanisation_report.pdf originally sourced from www.citymayors.com.
4. A 2015 UNESCAP report shows South and Southwest Asia was the most affected sub-region in the world in terms of number of natural disasters that hit them and the amount of loss of life and economy.
5. While urban poverty is an important aspect contributing to informalities in Indian cities, researchers have argued that informalities in India's urban planning regime are marked by "state of deregulation, ambiguity, and exception." Roy, Ananya; Research Article: Planning Theory "why India Cannot Plan its Cities: Informality, Insurgence and the Idiom of Urbanisation," SAGE publication (http://journals.sagepub.com/doi/abs/10.1177/1473095208099299).

Further Reading

Ahmad, O. 2016. Interview: Gautam Bhan on the "Encroacher" Versus the "Citizen." *THE WIRE*.

Bhan, G. 2015. From Slums to Neighbourhoods. *The Hindu*.

———. 2016. A City is for All Its Citizens. *The Hindu*.

Census of India. 2011. *Provisional Population Totals Urban Agglomerations and Cities*.

Guttikunda, S.K., R. Goel, and P. Pant. 2014. Nature of Air Pollution, Emission Sources, and Management in the Indian Cities. *Atmospheric Environment* 95: 501–510.

Jain, M., H. Taubenböck, and S. Namperumal. 2011. Seamless Urbanisation and Knotted City Growth: Delhi Metropolitan Region. Paper presented at the REAL CORP 16th International Conference 'Change for stability: Lifecycles of Cities and Regions', Essen.
Khosla, R. 2017. India's Urban Landscape. *Economic Political Weekly* 52: 92–101.
Mishra, N. 2015. *The Village That Could Be a Town. The Indian Express*, January 5.
Mukherjee, M., N. Chindarkar, and J. Grönwall. 2015. Non-Revenue Water (NRW) and Cost Recovery in Urban India: Case of Bangalore. *Water Policy* 17 (3): 484–501.
Pradhan, K.C. 2013. Unacknowledged Urbanisation: The New Census Towns of India [WWW Document]. Central Policy Research. URL http://www.cprindia.org/articles/unacknowledged-urbanisation-new-census-towns-india.
Urban Water Supply and Sanitation in Indian Cities. 2015. National Institute of Urban Affairs.
Water and cities [WWW Document]. n.d. Int. Decade Action Water Life. URL http://www.un.org/waterforlifedecade/water_cities.shtml.

References

Aggarwal, Mayank. 2016. High Air and Water Pollution in India's 41 Tier-II Cities. *Live Mint*. http://www.livemint.com/Politics/r8blEXdbvNDhWmoylH7b5K/High-air-and-water-pollution-in-Indias-41-tierII-cities.html.
Airpocalypse: Assessment of Air Pollution in Indian Cities. 2017. *Greenpeace*. http://www.greenpeace.org/india/Global/india/Airpoclypse--Not-just-Delhi--Air-in-most-Indian-cities-hazardous--Greenpeace-report.pdf.
Bhagat, R.B. 2011. Emerging Pattern of Urbanisation in India. *Economic & Political Weekly* XLVI (34): 10–12.
Bhattacharya, Shrimoyee, Sujaya Rathi, Sonali Anusree Patro, and Niepukhrie Tepa. 2015. *Reconceptualising Smart Cities: A Reference Framework for India*. Center for Study of Science, Technology and Policy (CSTEP). http://niti.gov.in/writereaddata/files/document_publication/CSTEP%20Report%20Smart%20Cities%20Framework.pdf.
Bhattacharya, Shrimoyee, Sonali Anusree Patro, Vivek Vaidyanathan, and Sujaya Rathi. 2016. *Localising the Gender Equality Goal Through Urban Planning Tools in South Asia*. Center for Study of Science, Technology and Policy. http://deliver2030.org/wp-content/uploads/2017/01/cstep_final.pdf.
Census of India. 2011. *Provisional Population Totals Urban Agglomerations and Cities*. http://censusindia.gov.in/2011-prov-results/paper2/data_files/India2/1.%20Data%20Highlight.pdf.
Dash, Dipak Kumar. 2013. 22 of India's 32 Big Cities Face Water Crisis. *The Times of India*. http://timesofindia.indiatimes.com/india/22-of-Indias-32-big-cities-face-water-crisis/articleshow/22426076.cms.

Gadepalli, Ravi. 2016. Role of Intermediate Public Transport in Indian Cities. *Economic & Political Weekly LI* 9: 46–48. http://shaktifoundation.in/wp-content/uploads/2016/03/Ravi_article.pdf.

Ground Water Scenario in Major Cities of India. 2011. Central Ground Water Board (CGWB). www.indiaenvironmentportal.org.in/files/GW-Senarioin cities-May2011.pdf.

Impact of Urbanisation on Biodiversity. 2012. http://www.wwfindia.org/?6980/.

India Energy Outlook (World Energy Outlook Special Report). 2015. International Energy Agency.

Joshi, Rajkumar, Sirajuddin Ahmed, and Carla Aparecida Ng. 2016. Status and Challenges of Municipal Solid Waste Management in India: A Review. *Cogent Environmental Science* 2 (1). https://doi.org/10.1080/23311843.2016.1139434.

Mishra, Neelkanth. 2015. *The Village That Could Be a Town*. http://indianexpress.com/article/opinion/columns/the-village-that-could-be-a-town/.

NAQI status of Indian cities. 2015. http://cpcb.nic.in/upload/Latest/Latest_119_NAQI-StatusIndianCities-2015-16.pdf.

Pollution Assessment: River Ganga. 2013. Central Pollution Control Board (CPCB). http://www.cpcb.nic.in/upload/NewItems/NewItem_203_Ganga_report.pdf.

Press Information Bureau Government of India Ministry of Urban Development. 2017. http://pib.nic.in/newsite/PrintRelease.aspx?relid=159951.

Rajashekariah, Kiran. 2014. *Foot Printing India's Urban Middle Class*. https://papers.ssrn.com/sol3/papers.cfm?abstract_id=2489039.

Ramachandra, T.V., K. Shwetmala, and T.M. Dania. 2014. Carbon Footprint of the Solid Waste Sector in Greater Bangalore, India. In *Assessment of Carbon Footprint in Different Industrial Sectors, Volume 1*, ed. S. Muthu. Singapore: Springer. EcoProduction. https://doi.org/10.1007/978-981-4560-41-2_11.

Revi, A., D.E. Satterthwaite, F. Aragón-Durand, J. Corfee-Morlot, R.B.R. Kiunsi, M. Pelling, D.C. Roberts, and W. Solecki. 2014. *Urban Areas*. Cambridge, United Kingdom and New York, NY, USA: Climate Change 2014: Impacts, Adaptation, and Vulnerability. Part A: Global and Sectoral Aspects. https://www.ipcc.ch/pdf/assessment-report/ar5/wg2/WGIIAR5-Chap8_FINAL.pdf.

Review of Urban Transport in India. 2014. Centre for Study of Science, Technology & Policy and Review of Urban Transport in India Institute of Urban Transport (India). http://www.indiaenvironmentportal.org.in/files/file/Review%20of%20Urban%20Transport%20in%20India.pdf.

Rohilla, Suresh Kumar, Bhitush Luthra, Shantanu Kumar Padhi, Anil Yadav, Jigyasa Watwani, and Rahul Sanka Varma. 2016. *Urban Shit: Where Does It All Go?* Down To Earth. http://www.downtoearth.org.in/coverage/urban-shit-53422.

Sanyal, Sanjeev, Sumati Nagrath, and Gorika Singla. 2010. *Urbanisation & Sustainability in India: An Interdependent Agenda*. THE ALTERNATIVE URBAN FUTURES REPORT. World Wildlife Fund (WWF). http://assets.wwfindia.org/downloads/urbanisation_report.pdf.

Shah, Mihir. 2016. *Urban Water Systems in India: A Way Forward*. INDIAN COUNCIL FOR RESEARCH ON INTERNATIONAL ECONOMIC RELATIONS. http://icrier.org/pdf/Working_Paper_323.pdf.

Species and Spaces, People and Places. 2014. *Living Planet Report*. WWF International, Institute of Zoology, Global Footprint Network and Water Footprint Network. http://awsassets.panda.org/downloads/lpr_living_planet_report_2014.pdf.

Urban Population (India). 2015. The World Bank. http://data.worldbank.org/indicator/SP.URB.TOTL?end=2015&locations=IN&start=1989.

Urban Population Growth (Annual %). 2015. The World Bank. http://data.worldbank.org/indicator/SP.URB.GROW.

Varma, Subodh. 2014. 42% of Urban, 60% of Rural Indian Houses Getting Contaminated Water: Study. *The Times of India*. http://timesofindia.indiatimes.com/home/environment/pollution/42-of-urban-60-of-rural-Indian-houses-getting-contaminated-water-Study/articleshow/33978229.cms.

Walkability in Indian Cities. 2011. Clean Air Initiative for Asian Cities (CAI-Asia) Center and Shakti Sustainable Energy Foundation. http://shaktifoundation.in/wp-content/uploads/2014/02/cai%20walkability%20final.pdf.

37

Sustainability in Africa: The Service Delivery Issues of Zimbabwe

Innocent Chirisa, Liaison Mukarwi, and Abraham R. Matamanda

Background

Service delivery is conceptualized as the relationship between policy makers, service providers, and poor people (Berry et al. 2004). It encompasses services and their supporting systems that are typically regarded as a state responsibility. These services include social services (primary education and basic health services), infrastructure (water and sanitation, roads and bridges), and services that promote personal security (justice, police) (ibid). Pro-poor service delivery refers to interventions that maximize the access and participation of the poor by strengthening the relationships between policy makers, providers, and service users. The human factor, in light of service delivery, includes a focus on the human side in the provision of services; this makes the service provision and management a community

I. Chirisa (✉)
Department of Rural and Urban Planning, University of Zimbabwe, Harare, Zimbabwe

Department of Urban and Regional Planning, University of Free State, Bloemfontein, South Africa

L. Mukarwi
Department of Rural and Urban Planning, University of Zimbabwe, Harare, Zimbabwe

A. R. Matamanda
Department of Urban and Regional Planning, University of Free State, Bloemfontein, South Africa

R. Brinkmann, S. J. Garren (eds.), *The Palgrave Handbook of Sustainability*,
https://doi.org/10.1007/978-3-319-71389-2_37

responsibility and economically sound and promotes transparency, accountability, and fairness in the process (Kauzya 2007; Berry et al. 2004). Sustainable service delivery ensures that current community service needs are delivered in a socially, economically, and environmentally responsible manner and does not compromise the ability of future generations to meet their own needs (UN-Habitat 2014).

The Theoretical Framework

The HFA involves "… a spectrum of personal characteristics and other dimensions of human performance that facilitate the functioning of sustainable social, economic and political institutions" (Adjibolosoo 1995, 33). These dimensions act like a legal system that helps to sustain the working and application of the rule of law that maintains and improves among other things human dignity and social welfare. Above all the effectiveness of this legal system is made possible through a network of committed individuals who stand by, believe in, and affirm to the ideals of the society. Adjibolosoo (2000) argues that the success of development work in developing countries is made possible through respect for human dignity which acts as the basis for social, economic, political, and environmental development.

The most important HF characteristics that need to be observed and inculcated in the people include personal character, love, care, concern, responsibility, integrity, accountability, commitment, loyalty, liberty, equality, and the sanctity of life. It is these principles that bring positive changes in the people's social, economic, and political lives. Hence, Adjibolosoo (2000) encourages the international relief workers and planners to understand how these principles can be integrated in development projects and plans. In this regard, Adjibolosoo (2006) illustrates that ancient scholars in all fields, politicians, social reformers, and social thinkers, were able to create principles governing the best way any community could function because they believed in the importance of HFA in developing and sustaining a just and social order and efficient political economy of development. Examples are drawn from all over the world from leaders such as Nelson Mandela, Mother Teresa, Dr. Martin Luther King Jr., and Adam Smith, among others. The HF philosophy of development that was adopted by the afore-mentioned leaders was premised on the fact that since it is people who determine whether things happen or do not happen, it is imperative that the initial development of plans, policies, programs, and projects integrate HF traits as the bedrock of such developments. Hendry et al. (1995, 100) share the same perspective and argues that:

> People are the actors through whom strategy unfolds, as a result of which firms succeed or fail …. People act, among other things, as owners, as entrepreneurs,

as sources of skill and expertise, as collaborators, as participants in network and learning activities, as agents of their own careers….

Adjibolosoo (2000) warns that those who fail to develop the appropriate HF traits in themselves will neither attain nor sustain any long-term progress. The implication is that HFA is premised on sustainability; hence it emerges as the cornerstone of sustainable development. However, HFA is the missing link in the development plans and projects in developing countries as Adjibolosoo (2000) indicates that failure of efforts to transform and improve social, economic, and political conditions in developing countries is attributed to the inability of these countries to capitalize on HFA in leadership and labor force. Therefore, unless HFA is adopted, no meaningful development can be achieved in developing countries, rather poverty will manifest while the living standards will remain below sustainable thresholds. Good governance is linked to the quality of the human factor (HF) and works well to cement relationships among players in an economy (UN-Habitat 2014). Therefore, promotion of good governance is a requisite pillar for ensuring sustainable development and the building of a resilient nation (ibid).

The central message that emerges from HFA is a decidedly political one relating to lack of good governance. The good governance idea as a factor of sustainable development should be located within the cultural pillar of sustainability which has been argued to be the overarching pillar in sustainability. It underscores both the crucial importance of good governance and the role of public participation in community and governmental decision-making. Figure 37.1 shows that human capital forms the greatest treasure for sustainable development. The development of a healthy, skilled, and productive workforce should be promoted to ensure that the basic needs of the communities are met. Human capital forms the base of the ladder shouldering governance, environmental stability, and economic growth in the path to sustainable service delivery (Pretorius and Schurink 2007). Human capital is a product of

Fig. 37.1 Sustainable service delivery ladder (Source: Adapted from Pretorius and Schurink's Retro Advanced Leadership Model (2007: 27))

the human factor approach (HFA) which crustiness the knowledge, skills, attitudes, behavior, and character of public administrators (officials), the private sector, the civil sector, and the public, and it seeks to boost the relationships among these players toward service provision and monitoring.

Sustainable service delivery is premised on stakeholder participation; hence the development plans should be extended beyond compilation of such but to include implementation and monitoring (Dewa et al. 2014; Munzwa and Jonga 2010; Kauzya 2007). Public officials in this regard therefore serve to necessitate dialogue on service delivery. Environmental stability involves multi-sectorial partnerships that promote better integration and coordination of sector initiatives to create sustainable communities through protecting the environment (Pretorius and Schurink 2007). Such partnerships should be promoted because it is after integration of environmental concerns that economic growth in prioritizing the enhancement of service delivery can be promoted. Furthermore, macro-economic plans to address poverty and unemployment in the country or district are very necessary since they have the potential to provide resources for service delivery (ibid). The economic growth gives the financial blessing to service provision.

Regardless of the intensity of past and present attempts to solve the problems of service delivery in Africa, there are comparatively little successes in such endeavors (Berry et al. 2004). Many government and non-government agents and organizations have been fighting losing battles for several decades in relation to the economic, social, political, and environmental challenges that burden Africa. The challenges are neither being met nor the problems being dealt with effectively (ibid). It is often assumed that among the most important determinant of increased output are advances in technology, financial resources, and equipment and improvement in organization at both macro and micro levels. Rather, this notion seems not to hold water as proponents such as Adjibolosoo (1995, 2000, 2006), Berry et al. (2004), and Kauzya (2007) argue that HF is the missing link which stifles the success of development efforts in developing countries, Africa included. Therefore, it emerges that HF is the most important factor that makes increased productivity and sustainability in development efforts. Hence Kauzya (2007) proposes that the problems in service delivery in Africa are attributed to HF deficiencies, lack of right HF content to guard against corruption, and abuse of public resources for personal gain.

Africa has had its share of destructive conflicts in the world; these are very detrimental to service delivery. The African political instability and other related problems are basically a consequence of its leadership problem (Ong'ayo 2008). This stresses the need for good leadership for prosperity—a HF guaranteeing an environment friendly for economic growth. The notion of leadership that is committed to HFA has been hailed by Adjibolosoo (2006) who notes how ancient scholars, politicians, social reformers, and social thinkers

have managed to create social order and efficient political economy of development through adopting HFA. Adjibolosoo (2000) further notes that the HF characteristics of every leader and community member matter a great deal in the pursuit of attaining sustainable development. However, this has not been an easy task since developing leaders that will ensure that the continent plays a leading role in sustainable development is a challenge (ibid). The first aspect of this challenge concerns succession planning which in effect is preparation for leadership relay in the affairs of managing an institution, organization, or a country. Every leader at any level, in any sector, or any institution has the cardinal duty of ensuring that capable and effective leadership does not end with him or her, but this is not present in Africa (Ayee 2011).

This is an area where Africa is lacking, for example, presidents seeking to amend the constitutions in their own favor, seeking to lengthen the number of terms they serve despite the limit laid down in the same. This is the case in Rwanda; this practice is wrong and has caused a civil war in Rwanda which had stalled development and caused damage to many of the existing facilities (Chêne 2015). This paved way for the creation of deeply rooted problems that today have made void all efforts made in the past to put Rwanda on a sustainable economic footing. In such cases, the crisis to service delivery is not on finance or equipment but is based on poor leadership which is attributed to being a bad HF content (ibid). Efforts in this sense are through promotion of good governance and intensified leadership capacity building. Adjibolosoo (2000) supports the foregoing statement when he observes that economic growth and sustained human-centered development will not occur in the absence of personal responsibility, accountability, integrity, commitment, and selflessness which all boils down to good governance. Therefore, there is need to create positive minds in leadership that think beyond today but include future of the broader community systems approach in decision-making.

In 2012, the World Bank getting inspiration from successful projects in Chile introduced similar projects in Senegal, Zambia, Tanzania, and Kenya. The projects were designed to improve local infrastructure, train people to work on their own homes as well as providing the much-needed financial support to meet the construction costs of their homes (Recom 2012). While these projects were initially evaluated as a success, in the long term they failed to effectively address the housing problem in Africa. The failure of the projects had much to do with HF. For example, most people who had been allocated land to build on simply sold their land on to wealthier buyers while those who retained their land did not undertake any development work on their pieces of land. In many areas the intended improvements to infrastructure and services stalled or never began at all (ibid). The eventual failure of these projects made it impossible for these countries to keep up with the ever-increasing

demand for urban housing despite having financial aid from the World Bank. This supports the fact that merely encouraging African countries to put policies and programs in place that encourage and facilitate the inflow of financial resources and other kinds of capital from overseas to propel sustainable development are all inadequate for dealing with the problems of service delivery in Africa (Recom 2012; Ayee 2011; Kauzya 2007). This shifted the emphasis to improve urban management by equipping the HF with required knowledge, creating positive mind-sets in public officials, the public, and all non-state actors in the continent toward services provision (Recom 2012).

Most African states have been facing corruption as a major problem in propelling sustainable economic growth and service delivery (Chêne 2015). In some cases, the corruption has attained levels of gross and egregious theft which has played a major role in the impoverishment of the region and in the alienation of the people from their rulers. Corruption undermines democracy and good governance by flouting or even subverting formal processes, reduces accountability, distorts representation in policy making, compromises the rule of law, and results in the unequal distribution of services. More generally, corruption erodes the institutional capacity of government as procedures are disregarded and resources are siphoned off for other uses than service delivery (Pushak and Briceño-Garmendia 2011). The result of corruption is community-wide lack of trust which breeds discouragement and hopelessness as well as destroys social cohesion and ultimately leads to economic stagnation, strife, political alienation, and social decay (Adjibolosoo 2000). This is the major reason for delays and failure of public projects in Africa (ibid).

In addressing such ills for sustainable service delivery, most governments in Africa are advocating for good corporate governance. By corporate governance, organizations are mandated to employ and reward officials based on merit to close the expertise and skill gap in such offices (Pretorius and Schurink 2007). This is meant to match the job description with the equally suitable personnel who possess the required skills for the job. Also, on governance, there is promotion of public participation to increase idea sharing, transparency, accountability, and shared responsibility among the stakeholders (Kauzya, 2007). This is in a way done to avoid abuse of public funds meant for service delivery.

Overall, since the environment is everyone's responsibility, many international conventions have been ratified (UN-Habitat 2014). Economic growth must be achieved today while also allowing the future generations to enjoy the same. The continent has embraced sustainable infrastructure funding options which include public-private partnerships (Pretorius and Schurink 2007). This approach embraces the public sector in financing, provision, and

management of public infrastructure. This improves efficiency in service delivery as the private sector is best in giving and getting value of money from any investment. The socialistic approach has made many countries fail in their endeavor to provide services; thus including the private sector has been one solution to the improvement in service delivery (ibid). The non-state actors have capacity to employ personnel suitable for various portfolios in provision and management of certain services which is the reason why many have engaged in the privatization of previously state-owned enterprises. This has shown that the state entities sometimes lack competent human resources to turn around the fortunes of such parastatals hence privatization.

The Case Study: Zimbabwe

Zimbabwe had a series of events starting in the 1990s, which contributed to the dramatic decline of Zimbabwe's service delivery within communities. These included a failed attempt at Economic Structural Adjustment (1991–1995) which led to contraction of the civil service, to the collapse of the domestic industrial sector, and to massive layoffs; bitterly disputed Fast Track Land Reform Program (since 2000) which resulted in the transfer of land mostly from experienced white commercial farmers to inexperienced Africans—mostly absentee landowners or to smallholder producers poorly supported by agricultural extension and support services; cash handouts to appease grievances of war veterans in 1997 sparking an inflationary spiral; military intervention in the conflict in the Democratic Republic of the Congo leading to budgetary constraints and overspending; and persistent drought (Dewa et al. 2014; Chêne 2015). All these led to a contraction of the economy and rising urban and rural poverty. Rapid urbanization led to estimated annual urban population increases of six to eight percent, explosive growth of the urban informal economy, and the proliferation of informal alternative housing solutions (Rukuni 2006).

Over the past years Zimbabweans are haunted by challenges of deteriorating infrastructure (transport and energy), lack of clean water, poor waste management, limited access to health services, education services, inadequacy of housing or accommodation, poor environmental quality, and increased crime (Munzwa and Jonga 2010). This is clearly a sign of deteriorated service delivery from public institutions. In explaining this decay in service delivery, the following reasons were cited by most respondents who were interviewed: lack of funding, poor management and incompetence on the side of government, and corruption, poor governance, and political interference. It can be noted

that most of the reasons relate to HF as a cancer in service delivery. This is in the form of poor governance, lack of required skills and expertise, corruption, and political polarization (Zinyemba and Zinyemba 2013). This concurs with the arguments raised by Adjibolosoo (2000) that economic growth and sustained human-centered development will not occur in the absence of accountability, integrity, commitment, and selflessness. Furthermore, the lack of human resources with technical, social, and ethical integrity is a common difficult experience leading to ineffective utilization of funds and resources (ibid). Quality human capital is an important success factor for governments to work toward building a safe and peaceful environment basing on sustainable social, economic, and physical goals whereby providing a better life for all the people in the area is done through transparent and accountable governance (Kauzya 2007; Adjibolosoo 2006).

Housing and Urban Land Delivery

The combination of poor human capital, economic decline, rapid urbanization, and poverty growth's negative effects are also evident in the housing sector (Chirisa 2013). The National Housing Policy of 2012 acknowledges a national cumulative backlog of over one million housing units, which is indicative of serious housing deficit. The government has been compelled to call for a more flexible approach to housing delivery. In this regard government reiterated the need for a broader response, including incremental housing production as a means of responding to demand (ibid). These included the allocation of un-serviced stands (plots) to individuals, housing cooperatives, and building societies to encourage self-help incremental housing schemes. Other initiatives in the housing sector include public-private partnerships in servicing the land and construction of houses (Munzwa and Jonga 2010). This has an impact of increasing investment in housing against the background of the government's failure to service stands due to financial constraints. An example of such partnership is one which exists between the City of Harare and CABS. This partnership has involved the construction of houses in Budiriro, a low-income residential areas, west of Harare. Local authorities have also engaged in slum upgrading shying away from demolitions, for example, Dzivarasekwa Slum upgrading done by Harare City Council in partnership with Dialogue on Shelter. The permission granted to housing cooperatives to service and build houses for their members has been another commendable initiative which had seen them contributing almost 49 percent of the housing stock in Mutare in 2010 (Dewa et al. 2014). Though the government is making strides to bridge the housing deficit in the country, there are little successes

recorded due to various reasons, chief among these being human conduct in the process.

Local authorities and the government have been criticized for being complicit in the exploitation of the citizens who are in desperate need of shelter by allowing the illegal urban settlements to develop under their watch and then demolish their dwellings under the guise of restoring sanity and order to the housing sector (Chirisa 2013). This is a failure in spatial planning on the side of authorities involved signifying the great need of investment in human capital to have public officials adequately equipped for the task in housing delivery. On the other hand, the officials lack a concern, care, and love for the citizens as outlined by Adjibolosoo (2000). Unscrupulous land barons and corrupt housing cooperatives also take advantage of desperate prospective home seekers by misappropriating their financial contributions (Zimbabwe Independent 2014). Corruption in the housing sector range from double booking of stands by cooperatives and unfair land/stand distribution to favoritism in plan approvals at various local authorities throughout the country; this is hindering smooth service delivery more than any other factor (ibid). There are severe conflicts, civil disputes over land ownership between residents and cooperatives, politicians, and companies which has nothing to do with financial resources or equipment as many would suggest, but this is a sign of human factor deficiencies. Unless the citizens as well as the officials in various offices uphold the HF characteristics that are outlined by Adjibolosoo (1995, 2000), no meaningful development will ensure in the housing sector in Zimbabwe.

Water and Sanitation

Water service provision continues to dog most water utilities in Zimbabwe. The water challenges are evidenced by unrelenting water shortages which forces people to use unsafe water sources leading to outbreak of waterborne diseases such as cholera. Structures, systems, and overall performance dramatically declined to an extent that in 2008–2009 the cholera outbreaks led to at least 4000 deaths, mainly in Harare (The Standard Newspaper 2016; Mangizvo and Kapungu 2010). The major setback in water delivery is the inefficiencies of water utilities, and the problem is magnified in urban areas due to limited alternatives.

Having known this, many can attribute the problem to lack of financial resources to construct and maintain water utilities leading to water shortage, but with good human factor content, the little resources available would lead

to sustainable water delivery (Mangizvo and Kapungu 2010). The use of one source, one system, and one discharge approach assumes that all water should be treated to the drinking water standard regardless of the purpose for which it will be used (human consumption, industrial use, or garden and park watering) (Mangala 2010). This strains the little financial resources available in the purification process; thus with skilled and competent manpower in water engineering, water should be treated according to use. Most of the purified water is used in industries, vehicles, factories as coolants, cleaning, and even for flushing in toilets. Given the erratic rainfall, it becomes a HF initiative to conserve the available water and adoption of water harvesting techniques (ibid). Some local authorities have been given financial resources to revamp water situation, but up to date nothing has been done due to corruption, faulty tendering, and misuse of those funds. A good example is Ruwa's allocation of US$3.5 million in 2011 by PSIP to finance water and sanitation in the town, but little has been achieved to date (The Standard Newspaper 2016).

The initiatives by the local authorities and non-state actors in terms of water delivery have been more on the supply side. The Bulawayo City Council has rested its hopes on the Zambezi Water project to bring more water in the city (*The Guardian* 2014). With the help of the Environmental Management Agency, the government and local authorities are in a move to curb pollution particularly water pollution. Water pollution has seen the Harare Water Treatment bill stretching to over a million dollars for water treatment chemicals due to unrelenting water pollution in Lake Chivero (City of Harare 2016). This is a suitable move as it boosts water quality and quantity and increases environmental quality. EMA is on a blitz to fine all entities discharging waste into the environment whether solid, liquid, or gas. This is in line with sustainability principles. However, some local authorities are culprits in polluting water by discharging raw sewer in water bodies, for example, Chitungwiza discharging sewer in Manyame River. The government, through the budgetary allocation, supports water and sanitation infrastructural projects around the country. Recently, the government granted a loan to Harare City Council from China Exim Bank meant to refurbish the water and sewer treatment plant (City of Harare 2016). Due to decay in the human capital, part of the loan was said to have been used to acquire executive cars for the administrators. Also, the misappropriation of the funds simply denotes a lack of HF characteristics— as there seem to be a lack of regard for human integrity since water is assumed to be life. The officials simply disregarded this view.

Irrigation

Climate change and rainfall variability has made agriculture more precarious than ever by limiting water availability (Mangala, 2010). Rain-fed agricultural activities have been severely reduced which has called for adoption of new models of farming like irrigation (The Chronicle 2014). This has been advocated by the state and non-state actors with the government calling for funding to propel the food production through irrigation. The government has shown its commitment to support the irrigation programs in the country through deals such as the multi-million-dollar deal signed on November 15, 2013, between Zimbabwe and ZTE, a Chinese company. The Chinese firm was to provide all the requisite equipment that would enable the execution of a successful irrigation project (Zimbabwe Independent 2014). On the other hand, the financial challenges burdening the government emerge as a barrier to the successful completion of major dam construction projects, such as Gwayi-Shangani, Kunzvi, and Tokwe-Mukosi. It has, however, managed to secure irrigation equipment under a $98 million loan signed with Brazil as part of its efforts to revive obsolete irrigation schemes across the country (ibid). NGOs like CARE International have also established several irrigations programs across the country; the major focus was on funding equipment and implementing irrigation schemes. These combined efforts, however, have not been as fruitful as they must be.

The HF was on several occasions being overlooked which made most irrigation projects to only thrive during the government or NGO support era. Rozva irrigation scheme located in Bikita District of Masvingo province is fully government managed but its performance from the start has been poor. At the planning stage farmers were opposed to the project as they felt the government was imposing the project on them. This case is a clear indication of the argument raised by Adjibolosoo (2000) that discouragement and hopelessness are bred from community-wide lack of trust in certain development projects. According to FAO (2016), AGRITEX is supposed to maintain the infield infrastructure, yet it is not delivering this service resulting in reduction in productivity. The failures in these projects are because of poor management; signifying bad HF content. This is a clear sign that making the human capital right makes every investment sustainable. In Guruve, villagers stressed the need to have access to water resources on irrigation but they no longer have the capacity due to lack of funds and most of the irrigation equipment that was on the farms has been stolen and totally vandalized. While irrigation would go a long way in securing Zimbabwe's food security, it requires energy,

which Zimbabwe is also grappling with (Zimbabwe Independent 2014). Diesel-powered irrigation schemes mean significant cash investment in procuring the fuel, while electricity-driven schemes run up significant bills. Therefore, it can never be over-repeated that human resources are the determinant factor in any endeavor because human resource capacity considers the variety of knowledge and skills required to successfully undertake technical, managerial, administrative, entrepreneurial, technological, political, and integrative activities for harnessing sustainable development (Kauzya 2007).

Other Initiatives Envisaged for Sustainable Service Delivery in Zimbabwe

In the power sector, the government is destined to full rehabilitation of the national power grid, and by 2020 addition of new generation capacity required to sustain strong economic growth. Projects underway include expansion of the Kariba South Hydropower Unit funded by a loan from China (GoZ 2016). In terms of expertise, there are Chinese engineers spearheading that project. In transport, the road authorities are pushing for rehabilitation of a large part of the national road network through public-private partnerships, for example, the dualization of Harare-Beitbridge road which is expected to kick-start soon (ibid). The rehabilitation of the railways network and restructuring of the industry through the creation of a new public entity that would own, maintain, and manage the basic track infrastructure, the restructuring of the National Railways of Zimbabwe (NRZ) into a privatized railways services company, and the award of concessions for freight and passenger services on the entire rail network are in the planning stages.

The civil aviation has engaged in upgrading the status of air traffic communications and safety in Zimbabwe to a standard consistent with the requirements of the ICAO. In this vein concessions have been awarded for the upgrade and operation of the Victoria Falls and Buffalo Range airports with the view to promote the growth of tourism, and the rehabilitation and upgrade of the remaining nine airports that would continue to be managed by the Civil Aviation Authority of Zimbabwe (GoZ 2016). The country has also started the development of a national communications grid for ICT based on a fiber optic network linked to the submarine cables now in place along the eastern seaboard of Africa (ibid). The grid would lay the foundations for a major expansion in access to reliable communications at reasonable cost for a majority of Zimbabweans, the business community, government, and civil society. Of importance, the government is instating institutional and

regulatory reforms. A substantial program of institutional reform and strengthening that includes measures to streamline the regulation of basic infrastructure services promotes private investment in infrastructure assets and services, as well as training and other capacity building measures to expand the skills required within the public sector for continued effective oversight and management of the basic infrastructure of the country (GoZ 2013). This shows efforts to make the human capital fit for the task through training.

Lessons Learned

From the foregoing discussion it emerges that human capital is a determinant factor in any endeavor. Without the human capacities, poverty cannot be eradicated because poverty destroys the human resource and poor human resources contribute to poverty—it is conceivable that the development needs of an area cannot be met without the requisite human capacities. However, developing human capital depends on creating legitimacy and trust through establishing strong participation mechanisms and by defining in a transparent manner the roles and relationships of different sectors as well as spheres of government. To achieve this transparency, leadership needs to make a shift from bureaucratic methods to participatory and collaborative ones to promote sustainable development. Essentially, leadership should avoid piecemeal development strategies that detach the past from the present and the present from the future. Participation promotes transparency, idea sharing, partnerships, and collaboration in problem analysis and planning, as well as consistent feedback on achievements and shortfalls. The rationale is to promote good governance which emerges as an essential component in sustainable development and service delivery. On the other hand, sustainable service delivery is also a product of cooperation where leaders at local, national, regional, and international levels in the public and private sectors as well as civil society engage in shared exercise of power and responsibility for the development of the community. Despite acknowledgment of all this, corruption stands in the way and stifles the institutional capacity of the government to deliver on its mandate. Above all, sustaining legitimacy and trust includes the development of a management/administrative and political culture based on the rule of law, ethical behavior, as well as professional conduct sustained by integrity of leadership. Evidence-based policies or interventions are critical in sustainable service delivery.

Challenges and Barriers

Financial resource shortages are causing a deterioration of services provided by local authorities and the government (GoZ 2013). The public authorities are pointing at poor cash flows as the root cause of the problem in sustainable development. The shortage is also attributed to low cash flows (FDI and own investments), high rates of corruption, gross abuse of council property, and hefty salaries of public officials (Mangizvo and Kapungu 2010). Local authorities are failing to pay their staff resulting in the diversion of funds set aside for service delivery. The dwindling tax base has also seen a severe reduction in government expenditure on gross capital formation (Zimbabwe Independent Newspaper 2014). This means that as a country, it does not have resources to fund infrastructure development which end up being funded through loans. This of course makes it expensive and delays the net return to the country (ibid).

Political instabilities and polarization in Zimbabwe are affecting sustainable service delivery initiatives. The periods before and after elections are usually characterized by political polarization and inter-party conflicts which lead to political instability and segregation (selective access to services) according to political party lines (Zinyemba and Zinyemba 2013). This situation led to significant capital and skills flight and erosion of public financing, thus severely affecting the country's capacity to deliver basic social services. It also weakened the national governance and accountability institutions and reduced the country's capacity for effective economic planning and implementation (ibid). Thus, planned interventions must take into account the differentials in political situation if the population is to participate and benefit equitably from the recovery process. This contributes to institutional and regulatory inadequacies which also resulted in minimal amounts of investment by the private sector in basic infrastructure, despite periodic efforts to attract such investment (Ayee 2011).

Zimbabwe has been facing cancerous corruption as a major problem to service delivery (Zimbabwe Independent 2014). The existence of widespread corruption, especially in a country plagued by mass poverty and very high levels of unemployment, has deeply corroded trust in government and contributed to the perpetuation of crime (ibid). This had undermined democracy and good governance by subverting formal processes in delivery and accessing of services. This has stalled the initiatives toward sustainable service delivery as resources are siphoned off for personal gains. The constrained trust in the government and/or public entities has led to serious vandalism of public

property, reduced cooperation from the public, and even resistance to government projects (Zinyemba and Zinyemba 2013).

Poor governance in the form of centralization affects service delivery. Rukuni (2006) noted that most of the water challenges that have been faced in urban areas are a consequence of mismanagement and reluctance by the Ministry of Local Governance to let the city council independently run water supply and sewer reticulation management. This concurs with Chigwenya's (2010) conclusion that decentralization of local authorities has been curtailed by the heavy presence of the government's hand in all sectors despite the provisions by the new constitution, as it continued to interfere with the day-to-day running of the municipality affairs. This therefore means that the local authorities lack autonomy in making independent decisions and policies toward addressing the crisis in service delivery. They should be ultimately responsible and accountable for municipal service delivery.

No sustainable economic development and service delivery will happen in the country until it can manage its economy better. In addition, there has to be, in place, a government that is not only accountable but spends less on consumption and more on capital formation. Such a scenario calls for competent and skilled personnel for effectie management and implementation of policies in the country.

Further Reading

Adjibolosoo, S. 1995. *The Human Factor in Developing Africa*. Westport: Praeger.

———. 2000. *The International Development Program of Activities: What Are We Doing Wrong?* Paper presented at the October 2000 CBFA Conference, Ohio.

———. 2006. *Developing Civil Society: Social Order and the Human Factor*. Burlington: Ashgate Publishing Limited.

Ayee, J.R.A. 2011. *Social Inclusion and Service Delivery in a Fragile and Post-Conflict Environment in Africa*, Occasional paper No. 15. Harare: The African Capacity Building Foundation.

Berry, C., A. Forder, S. Sultan, and M. Moreno-Torres. 2004. *Approaches to Improving the Delivery of Social Services in Difficult Environments,* PRDE Working Paper 3. London: UK Department for International Development.

Chêne, M. 2015. Zimbabwe. *Overview of Corruption in the Health and Education Sectors and in Local Governments*.(06).

Chigwenya, A. 2010. Decentralization without Devolution and Its Impacts on Service Delivery: The Case of Masvingo Municipality in Zimbabwe. *Journal of Sustainable Development in Africa* 12 (1): 1–12.

Chirisa, I. 2013. Building and Urban Planning in Zimbabwe with Special Reference to Harare: Putting Needs, Costs and Sustainability in Focus, Consilience. *The Journal of Sustainable Development* 11 (1): 1–26.

City of Harare. 2016. *State of the City Address - March 2016*. Paper Presented at the Harare Council Board Meeting by the Harare Mayor, Harare. March 1.

Dewa, D., C. Dziva, and K. Mukwashi. 2014. Exploring Local Governance Challenges in Zimbabwe Under the Government of National Unity Era and Beyond. *International Journal of Political Science and Development* 2 (8): 188–196.

FAO. 2016. Socio-economic Impact of Smallholder Irrigation Development in Zimbabwe. http://www.fao.org/docrep/x5594e/X5594e15.htm. Web Accessed 24 Mar 2016.

Financial Gazette. 2014. Zimbabwe: Made Botches U.S $100 Million Deal. June 12. http://allafrica.com/stories/201406121446.html. Web Accessed 23 Mar 2016.

GoZ. 2013. *Zimbabwe Agenda for Sustainable Socio-economic Transformation (Zim-ASSET)*. Government Printers: Harare.

———. 2016. *Zimbabwe 2016 Budget Statement*. Harare: Government Gazette.

Hendry, C., M.B. Arthur, and A.M. Jones. 1995. *Strategy Through People: Adaptation and Learning in the Small-Medium Enterprise*. London: Routledge.

Kauzya, J.M. 2007. *The Human Factor in Global Governance: Leadership Capacity Development Perspective in Africa,* Discussion Paper. United Nations, New York.

Mangala, J. 2010. *New Security Threats and Crises in Africa; Regional and International Perspectives*. New York: Palgrave Macmillan.

Mangizvo, V.R., and N. Kapungu. 2010. Urban Domestic Water Crisis in Zimbabwe: The Case of Kadoma City. *Journal of Sustainable Development in Africa* 12 (8): 254–263.

Munzwa, K., and W. Jonga. 2010. Urban Development in Zimbabwe: A Human Settlement Perspective. *Theoretical and Empirical Researches in Urban Management* 5 (14): 120–146.

Newsday Newspaper. 2016. Irrigation -The Ideal Solution to Droughts (online). Harare: Alpha Media Holdings. January 2. https://www.newsday.co.zw/2016/01/27/irrigation-the-ideal-solution-to-droughts/. Web Accessed 24 Mar 2015.

Ong'ayo, A.O. 2008. Political Instability in Africa Where the Problem Lies and Alternative Perspectives. Presented at the Symposium. *Afrika: een continent op drift.* Amsterdam: The African Diaspora Policy Centre.

Pretorius, D., and W. Schurink. 2007. Enhancing Service Delivery in Local Government: The Case of a District Municipality. *SA Journal of Human Resource Management* 3: 19–29.

Pushak, N., and C.M. Briceño-Garmendia. 2011. *Zimbabwe's Infrastructure: A Continental Perspective*. Washington, DC: The International Bank for Reconstruction and Development/The World Bank.

Recom. 2012. *Urban Service Delivery in Africa (online)*. http://recom.wider.unu.edu/article/urban-service-delivery-africa-and-world-bank. Web Accessed 22 Mar 2016.

Rukuni, M. 2006. *Zimbabwe's Agricultural Revolution Revisited*. Harare: University of Zimbabwe.

The Chronicle. 2014. Turkey to Provide Mechanization, Irrigation Expertise to Zimbabwe (online). Harare: Zimpapers. June 28. http://www.chronicle.co.zw/turkey-to-provide-mechanisation-irrigation-expertise-to-zimbabwe/. Web Accessed 24 Mar 2016.

The Guardian. 2014. Helping Bulawayo Find a Viable Solution to Its Water Crisis I. March 2 2016. http://www.theguardian.com/global-development-professionals-network/2014/jul/07/bulawayo-solution-water-crisis.

The Standard Newspaper. 2016. Harare Water Crisis Cause for Concern. Harare: Alpha Media Holdings. February 7.

Un-Habitat. 2014. *The State of African Cities 2014: Re-imagining Sustainable Urban Transitions*. Nairobi: UN-Habitat

Zimbabwe Independent. (online). 2014. Govt Must Root Out Entrenched Corruption. March 28. http://www.theindependent.co.zw/2014/03/28/govt-must-root-entrenched-corruption/. Web Accessed 24 Mar 2016.

Zimbabwe Independent Newspaper. (online). 2014. Infrastructure Development Key to Growth. November 17. http://www.theindependent.co.zw/2014/11/17/infrastructure-development-key-growth/. Web Accessed 24 Mar 2016.

Zinyemba, A., and R. Zinyemba. 2013. Service Delivery of Non-governmental Organizations in Zimbabwe: Challenges and Strategies. *University of Zimbabwe Business Review* 1 (1): 22–31.

38

Sustainable Transportation in Mexico

Nora Munguia and Velazquez Luis

Background

Several initiatives have been developed around the world to reduce carbon dioxide (CO_2) emissions. This chapter describes the experience of a "NO DRIVING DAY PROGRAM" in the City of Mexico; an initiative that restricted the use of certain vehicles in an effort to cut down on pollution in this sector. Because of several factors discussed below, the expected reductions in CO_2 have not been met stressing the need for long-term comprehensive sustainable strategies to reach a clean transportation system.

In an attempt to sustain productivity, most of the global productive systems heavily depend on fossil fuels, thereby generating CO_2, the most important cause of global warming and climate change. The 21st Conference of the Parties to the United Nations Convention on Climate Change (COP 21), also called Paris Agreement, offered a real hope for addressing climate change in a more timely, responsible, unified, equitable, and sustainable way (Roberts, 2016). One hundred and ninety-five countries signed this agreement to limit global temperature increases to less than 2 °C as a minimum and to strive for 1.5 °C. However, it is questionable whether achieving these goals is possible. There are doubts as to whether the wording of the agreement, although admirable, can sufficiently *operationalize* the path toward the stated goal (Mesík 2015).

N. Munguia • V. Luis (✉)
University of Sonora, Hermosillo, Sonora, Mexico

R. Brinkmann, S. J. Garren (eds.), *The Palgrave Handbook of Sustainability*,
https://doi.org/10.1007/978-3-319-71389-2_38

According to the Organisation for Economic Cooperation and Development (OECD), a sustainable transportation system is "one that does not endanger public health or ecosystems and meets mobility needs consistent with (a) use of renewable resources at below their rates of regeneration and (b) use of non-renewable resources at below the rates of development of renewable substitutes" (2002). As many other definitions, this one involves many uncertainties, and there may be a need for stronger debate about it. In spite of the discrepancies, people agree, at least, that transportation system sustainability should capture the attributes of the system effectiveness and system impacts on economic development, environmental integrity, and social quality of life (Jeon et al. 2013).

The boom in the transportation sector had generated air pollution and negative effects in human health. The transportation sector certainly contributes to climate change because it is the second largest generators of CO_2 emissions due to fossil fuel combustion. Transportation itself accounts for 28 percent of the total greenhouse gas (GHG) emissions in the USA (United States Department of State 2010) and 25 percent of GHG emissions in the European Union (European Commission 2014). This is the only sector in the world that does not contribute to reducing GHG emissions (Heinrichs et al. 2014). To be more sustainable, it is clear that the transportation sector requires smart interventions to change its unsustainable patterns.

The transportation sector comprises a larger number of activities necessary to move people or goods by cars, trucks, trains, ships, airplanes, and other vehicles; but, this chapter focuses only on the movement of people either by private or public transportation modes.

A sustainable transportation system is complex; therefore, finding the right balance among the three dimensions of sustainable development, environment, economy, and society is quite a challenge to meet. An interesting sustainability case study was shown in this chapter, a case study at the City of Mexico called "*HOY NO CIRCULA*", translated in English as the NO DRIVING DAY PROGRAM. In more than two decades, this program has attempted to reduce air pollution and protect the public health. However, the program has resulted in anger among the different groups in the society.

Case Study

According to the National Institute of Statistics and Geography of Mexico, in 2015, the city reached a population of over eight million, roughly 8,918,653 with a population density of 5967 persons per square kilometer (INEGI

2016). This density is huge taking into account that the national average is just 61 persons per square kilometer. Mexico City is the most crowded city in the country and also the most polluted.

The City of Mexico is faced with increasing air pollution and traffic problems since it became a megacity. More than 4.5 million vehicles commute to and from metropolitan areas, thereby contributing to the deteriorating quality of air (Transparencia DF 2016). By the mid-1980s, the government attempted to solve these problems by different means that included the production of cleaner fuels, the conversion from heating oil to natural gas by thermoelectric power plants, and the creation of a voluntary program that fostered among families a "no-car day" once a week.

At the beginning, the program operated just in winter from Monday to Friday, but after a short while, the program became permanent. Later, in 1990, the NO DRIVING DAY PROGRAM became mandatory.

In 1997, the program included the vehicle emission test in order to promote the use of more fuel-efficient vehicles with a catalytic converter. This allowed many of the late-model vehicles to avoid the day off. A decade after, in 2008, the program included Saturdays as a day off.

On July 2014, the program was again modified by including new rules. Electric or hybrid vehicles were exempted, via a designation of Hologram 00, from taking the emission test. Other similar exemptions were granted if vehicles were less than two years old. Other newer vehicles, those two to eight years old were designated with Hologram 0. Hologram 1 was granted to vehicles between 9 and 15 years old; they could not circulate one day per week and two Saturdays per month based on the last digit on the plate. Vehicles older than 15 years received Hologram 2 designations, and they could not circulate one day per week and all Saturdays according to the last digit on the plate. Restrictions applied each day from 5:00 to 23:00 hours. In 2015, rules changed and the only criterion for granting a hologram designation was the emission test and not the age or model of the car. This meant that older vehicles could access better holograms if they passed an emission test. Yet, all the above efforts seemed to yield very little results because air pollution in the city has increased beyond tolerable levels.

In the view of this dramatic environmental situation, the Comision Ambiental de la Megalopolis (Environmental Commission of the Mexican Megalopolis) decided, once again, to tighten up further the program's restrictions from 5 April to 30 June 2016. During that period, the holograms 00 and 0 were temporarily discontinued; therefore, all vehicles had to stop one day from Monday to Saturday with no regard to the hologram they had. Those measures included vehicles with federal plates, and for the first time

ever, the restrictions were valid for motorcycles. However, electric vehicles, school buses, public transportation vehicles, taxis, hazardous waste haulers, public security and civil protection vehicles, and natural gas vehicles were allowed to transit as usual. After this period of crisis, the program returned to the previous measures.

According to the official website of the NO DRIVING DAY PROGRAM, http://www.hoy-no-circula.com.mx/, the NO DRIVING DAY PROGRAM is currently in operation through holograms that are assigned according to the emission levels resulting from a six-monthly basis emission test. From the lowest to the highest pollution level, the hologram can be represented as, 00, 0, 1, and 2.

The last digit on the plate of the vehicle is also taken into account; if the last digit on the plate is 5 or 6, the color assigned is yellow; if the last digit is 7 or 8, the color assigned is pink; if the last digit is 3 or 4, the color assigned is red; if the last digit is 1 or 2, the color assigned is green; and if the last digit is 9 or 0, the color assigned is blue. Once the vehicle is characterized with a hologram and with the last digit on the plate, the program defines what day the vehicle can or cannot circulate in the city and the State of Mexico. This applies within the 16 Mexico City's delegations and the 18 municipalities of the State of Mexico.

A survey conducted by a national newspaper found that 49 percent of the respondents approved the program, while 48 percent of the respondents disapproved the program; the main reason is that people did not believe that the program could reach the promised benefits. Additionally, 64 percent of the respondents expressed that the public transportation system offers a poor service, and it is highly polluting (Moreno 2016).

Several newspapers reported on a street demonstration against the program that spread across the city. People argued that public transportation was insufficient, bad, and expensive for commuting. They also affirmed that the taxis and buses caused more pollution than private vehicles because they are not required to pass a vehicle emission test.

Amid the criticism concerning the NO DRIVING DAY PROGRAM, the majority of the City of Mexico made a statement to the press claiming that the health of the citizens is first and that the mandatory changes to the program were positive despite the popular opinion against the program. They argued that the amendments to the rules for commuting were not taken only for the City of Mexico but also for the Environmental Commission of the Mexican Megalopolis; therefore, it was a decision of the Federal Government. He reiterated that it was a temporary measure that has been implemented in many cities around the world. He said that five and a half million vehicles

circulating in the city and the weather conditions forced the government to take these steps, stating that as responsible politicians, mayors must take the right decision and bear the social and political costs (Excelsior TV 2016).

As far as sustainable development is concerned, the NO DRIVING DAY PROGRAM has been a failure because it cannot balance the environmental, social, and economic dimension. The environment has worsened, the society is angered, and the household economy has been affected.

Lessons Learned

As the case study left clear, to date, the NO DRIVING DAY PROGRAM has had a poor track record in dealing with the environmental, social, and economic dimensions of sustainable development of the City of Mexico. Therefore, the term lessons learned from this case study refers only to the negative aspects of the NO DRIVING DAY PROGRAM as a tool for reaching sustainability in the transportation system of the City of Mexico.

From the case study, it is possible to draw two principal lessons. First, the tightened restrictions to address vehicle traffic has not resulted in any significant improvements to the quality of air or to a significant improvement in reducing air pollution. On the contrary, the number of environmental contingencies has kept growing. During the 2016 Ozone Season alone, six pollution contingencies and four pollution pre-contingencies were activated (Comisión Ambiental Metropolitana 2016). In a certain way, it can be explained by the high level of emissions from the old public transportation buses and taxis. In fact, until recently, the public buses and taxis were exempted from taking the mandatory emission test. Another cause of the high air pollution levels stems from corruption, which is widespread at many emission-testing centers in the city (Delgado 2016).

The second lesson is broader. The full integration of the environmental, social, and economic dimensions in a balanced manner is complex, if not impossible. Of course, from the environmental dimension, the program seems a good deal; however, trying to improve air quality and protect human health with the implementation of the NO DRIVING DAY PROGRAM has exacerbated the social dimension.

The public transportation network is an important alternative to the daily mobility of millions of passengers in the city that includes buses, metro buses, the metro, and trams. Taxis and Collective taxis are also a way to commute. Although, from the environmental perspective, the use of public transportation mode is preferable over private motorized transportation modes, from

the social and economic dimensions, the program has upset the different groups in the society.

The NO DRIVING DAY PROGRAM challenged the public transportation system by increasing the demand for a limited capacity. On certain days and hours, the public transportation network capacity was not sufficient to transport the number of daily passengers traveling to their workplaces, schools, and other places in the city. Taxis were not a common alternative because they result to be unaffordable for most citizens. As a consequence, many citizens arrived late at workplaces, affecting their household economy.

In addition, the lack of safety in certain parts of the city has taken on the serious proportion that has affected the confidence of the people in using public modes of transportation. Recently, with regard to women's safety, the Thomson Reuters Foundations (2014) reported that the public transportation in the city of Mexico is the second worst in the world.

In trying to avoid such cumbersome situations, many people bought a second or even third vehicle in order to circulate during the entire week. This would not be a problem if the substitute cars were new model; however, this is not the case. According to a press release (Hernandez 2014), the NO DRIVING DAY PROGRAM along with the economic situation in the country has increased the selling of old and environmentally unfriendly cars and has led to large and growing fleets of private cars that worsen traffic and air pollution.

Over the last 26 years, this governmental program has aimed at minimizing environmental impacts due to daily transit, but despite the promised benefits not only for the environment of the city but also for the public health of the citizens, the opinion of the citizens in the City of Mexico and the metropolitan area is polarized.

Challenges and Barriers

The NO DRIVING DAY PROGRAM was designed to decrease air pollution, protect the health of Mexican citizens, and to promote sustainable public transportation. However, this is everything but sustainable and that is true not only from an environmental perspective but also from a social and an economic perspective. Even environmental activists have concluded that public transportation modes, including taxis, are one of the major sources of pollution.

This program opened a Pandora's box, exposing different visions that exist in a society for the environment—which is very difficult to close. Sustainability

is tied to diverse ways of thinking; consequently, the air pollution phenomenon cannot be controlled by one single measure. There is no reason to believe that tightening up the program's restrictions even further could help the NO DRIVING DAY PROGRAM succeed. Instead, this environmental crisis must be addressed with a comprehensive strategy, taking into account the three dimensions of sustainable development.

A sustainable future relies on decoupling economic growth and CO_2 emissions in the transportation sector; this is one big challenge; however, reaching sustainability in this sector comprises a series of strategies in the long term.

A wide variety of initiatives have been implemented around the world to reduce greenhouse gas emissions and air pollution from private and public transportation. Non-motorized transportation modes such as walking and cycling are clearly the best environmentally friendly alternatives for commuting; however, they are probably not suitable for long distances or for persons with reduced mobility, minors, and elderly people. The EcoBici System is an individual transport program of the government of the City of Mexico that is cutting CO_2 equivalent emissions by over 230 tons during the period from 2010 to 2012 (Secretaria del Medio Ambiente DF 2013).

Although vehicles produce air pollutants, there is no way to avoid motorized transportation; therefore, it should be seen as a strategy to keep mobility levels at their maximum, while keeping inequitable influences at their minimum, taking into account the environmental capacity constraints (Feng and Timmermans 2014).

One way of decoupling transportation and CO_2 emissions is by increasing the efficiency of cars; nowadays, car manufacturers have reached impressive results on this, and it is very likely that CO_2 emissions from new cars are going to be lower than present-day levels (Zachariadis 2013). A key factor for this has been the development of technology (Costa and Fernandes 2012). Thanks to technological development, automakers have introduced better catalytic converters (Farago et al. 2005), lightweighting vehicles (Kim et al. 2011), and mainly alternative fuels (Vahdani et al. 2011). Now, there is widespread use of motorized vehicles powered by compressed natural gas or biodiesel and common in some countries are the sale of cars powered by electricity, biofuels, or hydrogen.

The improvement of public transportation is an important challenge everywhere, not only regarding competitiveness but also regarding to safety and the environment. Improving the quality of service should reduce vehicle ownership while decreasing air pollution in ensuring the protection of public health. Luckily, the chances for increasing the use of public transportation would increase if commuters consider the service good enough (Jain et al. 2014). Yet,

there are many barriers to overcome. For instance, sizeable investments are needed in order to renew the fleet of public vehicles and/or to foster the buying of vehicles powered with several types of cleaner fuels. The Government has started to leverage private and public partnerships for investments in rapid bus transit (Mitric 2013), but these partnerships have been chaotic (Gwilliam 2013). For instance, it was popular in the USA to build public transit systems to revitalize urban cores and grow in a sustainable manner (Mathur and Smith 2013). However, in the longer term, they came to be problematic (Siemiatycki 2010).

Transportation systems are complex because they rely heavily on social factors such as the habits, customs, and needs of passengers. For this reason, ideological barriers are also presented in these kind of systems. Changes in behaviors, attitudes, and lifestyles are required for shifting to sustainable transportation modes (Klinger et al. 2013).

In conclusion, a more sustainable transportation system in the City of Mexico will require designing strategies to balance the three dimensions of sustainable development. Reaching sustainability in the transport sector will involve accepting trade-offs as a result of the complex relationship between the government and the society and between the technological and cultural aspects. The NO DRIVING DAY PROGRAM has included unilateral coercive measures that did not work at all for decreasing pollution. The reason is simply because sustainability cannot be decreed; the government in harmony with the society must build this.

Further Reading

Comisión Ambiental Metropolitana. *Programa para mejorar la calidad del aire de la Zona Metropolitana del Valle de Mexico 2011–2020*. http://respiramexico.org.mx/wp content/uploads/2015/07/proaire2011-2020.pdf. Web Accessed 7 Oct 2016.

Costa, A., and R. Fernandes. 2012. Urban Public Transport in Europe: Technology Diffusion and Market Organization. *Transportation Research Part A* 46 (2): 269–284.

Delgado Diana. 2016. Continua corrupción en los verificentros. *El Universal,* Mayo 22. http://www.eluniversal.com.mx/articulo/metropoli/cdmx/2016/05/22/continua-corrupcion-en-los-verificentros.

European Commission. 2014. *Reducing Emissions from Transport*. http://ec.europa.eu/clima/policies/transport/index_en.htm. Web Accessed 7 Oct 2016.

Excelsior TV. 2016. Mancera responde a criticos del nuevo hoy no circula. *YouTube*. https://www.youtube.com/watch?v=WCa296dcNVQ. Accessed 7 Oct 2016.

Heinrichs, H., P. Jochem, and W. Fichtner. 2014. Including Road Transport in the EU ETS (European Emissions Trading System): A Model-Based Analysis of the German Electricity and Transport Sector. *Energy* 69: 708–720. https://doi.org/10.1016/j.energy.2014.03.061.

Farago, M.E., E.J. Hutchinson, P.R. Simpson, and I. Thornton. 2005. Recent Increases in Platinum Metals in the Environment from Vehicle Catalytic Converters. *Applied Earth Science* 114 (3): 182–192.

Feng, T., and H. Timmermans. 2014. Trade-offs Between Mobility and Equity Maximization Under Environmental Capacity Constraints: A Case Study of an Integrated Multi-Objective Model. *Transportation Research Part C: Emerging Technologies* 43 (3): 267–279.

Gwilliam, K. 2013. Cities on Move-Ten Years After. *Research in Transportation Economics* 40 (1): 3–18.

Hernandez, Angélica. 2014. El Hoy no circula solo sirve para vender más coches: expertos. *El financiero*. http://www.elfinanciero.com.mx/economia/el-hoy-no-circula-solo-sirve-para-vender-mas-coches-expertos.html.

INEGI. *Agency Website*. http://cuentame.inegi.org.mx/monografias/informacion/df/poblacion/. Web Accessed 7 Oct 2016.

Jain, S., P. Aggarwal, P. Kumar, S. Singhal, and P. Sharma. 2014. Identifying Public Preferences Using Multi-Criteria Decision Making for Assessing the Shift of Urban Commuters from Private to Public Transport: A case Study of Delhi. *Transportation Research Part F: Traffic Psychology and Behaviour* 24: 60–70. https://doi.org/10.1016/j.trf.2014.03.007.

Jeon, C.M., A.A. Amekudzi, and R.L. Guensler. 2013. Sustainability Assessment at the Transportation Planning Level: Performance Measures and Indexes. *Transport Policy* 25: 10–21. https://doi.org/10.1016/j.tranpol.2012.10.004.

Kim, H.J., G.A. Keoleian, and S.J. Skerlos. 2011. Economic Assessment of Greenhouse Gas Emissions Reduction by Vehicle Lightweighting Using Aluminum and High-Strength Steel. *Journal of Industrial Ecology* 15 (1): 64–80.

Klinger, T., J. Kenworthy, and M. Lanzendorf. 2013. Dimensions of Urban Mobility Cultures – A Comparison of German Cities. *Journal of Transport Geography* 31: 18–29. https://doi.org/10.1016/j.jtrangeo.2013.05.002.

Mathur, S., and A. Smith. 2013. Land Value Capture to Fund Public Transportation Infrastructure: Examination of Joint Development Projects' Revenue Yield and Stability. *Transport Policy* 30: 327–335. https://doi.org/10.1016/j.tranpol.2013.09.016.

Mesík, J. 2015. Paris Climate Change Agreement: A Milestone or a Fake? *International Issues & Slovak Foreign Policy Affairs* 24 (4): 79–98.

Mitric, S. 2013. Urban Transport Lending by the World Bank: The Last Decade. *Research in Transportation Economics* 40 (1): 19–33.

Moreno Alejandro. 2016. Hoy No Circula Divide Opiniones. *El Financiero.* April 04. http://www.elfinanciero.com.mx/nacional/hoy-no-circula-divide-a-ciudadanos-49-esta-de-acuerdo-48-rechaza-medida.html

Organization for Economic Cooperation and Development (OECD). 2002. *Policy Instruments for Achieving Environmentally Sustainable Transport*. www.keepeek.com/Digital-AssetManagement/oecd/environment/policy-instruments-for-achieving-environmentallysustainable-transport_9789264176249-en#page1/. Web Accessed 7 Oct 2016.

Roberts, D. 2016. A Global Roadmap for Climate Change Action: From COP17 in Durban to COP21 in Paris. *South African Journal of Science* 112: 1–3.

Secretaria del Medio Ambiente DF. 2016. *Estudio de la reducción de emisiones y los co-beneficios generados por la implementación del programa ecobici*. https://www.ecobici.df.gob.mx/sites/default/files/pdf/reduccion_gei_y_co-beneficios_generados_por_la_implementacion_del_programa_ecobici_201020112012.pdf. Web Accessed 10 Oct 2013.

Siemiatycki, M. 2010. Delivering Transportation Infrastructure Through Public-Private Partnerships: Planning Concerns. *Journal of the American Planning Association* 76 (1): 43–58.

Thomson Reuters Foundations. 2014. *Ranking the Most Dangerous Transport Systems for Women in Major Cities*. http://thomsonreuters.com/en/articles/2014/most-dangerous-transport-systems-for-women.html. Web Accessed 10 Oct 2016.

Transparencia DF. 2016. *Organization Website*. http://www.transparenciamedioambiente.df.gob.mx/index.php?option=com_content&viw w=article&id=172&Itemid=437. Web Accessed 10 Oct 2016.

United States Department of State. 2010. *US Climate Action Report 2010*. http://unfccc.int/resource/docs/natc/usa_nc5.pdf. Web Accessed 7 Oct 2016.

Vahdani, B., M. Zandieh, and R. Tavakkoli. 2011. Two Novel FMCDM Methods for Alternative-Fuel Buses Selection. *Applied Mathematical Modelling* 35 (3): 1396–1412.

Zachariadis, T. 2013. Gasoline, Diesel and Climate Policy Implications – Insights from the Recent Evolution of New Car Sales in Germany. *Energy Policy* 54: 23–32. https://doi.org/10.1016/j.enpol.2011.11.075.

39

Sustainability in Small States: Luxembourg as a Post-suburban Space Under Growth Pressure in Need of a Cross-National Sustainability

Constance Carr

Background

Over 25 years ago, at the United Nations conference in Rio, local governments were called on to take action toward sustainable development. It was believed that the best way to achieve a new paradigm of global sustainability was through a multiplicity of local initiatives. In practice, the directive translated into a call to urban planning departments worldwide to re-examine their planning traditions and explore ways to foster sustainable development. Europe responded (Krueger and Gibbs 2007), and till today the moniker of sustainable development remains a powerful concept in European urban planning circles. However, several scholars have documented the limited success thus far. Carr et al. (2015) showed how sustainable development policies in Europe have, in practice, achieved very little headway in terms of addressing the fundamental underlying problems that triggered the call for sustainable development in the first place: sometimes the formulation of sustainability was too fuzzy and blurred; sometimes the approaches were too top-down and insensitive to specific local variations; sometimes planners and activists (alike) were so fixated on planning orthodoxies—such as density or integration—that the point was missed altogether; and, sustainability approaches have increasingly been driven by market forces. These authors show that there is no recipe for sustainability to date.

C. Carr (✉)
Geography and Spatial Planning, University of Luxembourg, Esch-sur-Alzette, Luxembourg

R. Brinkmann, S. J. Garren (eds.), *The Palgrave Handbook of Sustainability*,
https://doi.org/10.1007/978-3-319-71389-2_39

While this chapter generally addresses sustainability in Europe, it zeroes in on one particular kind of sustainability dilemma found on the continent—that of small states under growth pressure, unfolding as post-suburban spaces. The chapter draws on the case of Luxembourg, but the challenges can be echoed in other bordered spaces across the continent as well—such as Switzerland, or perhaps Monaco, Lichtenstein, or Belgium—and contrasts other European contexts such as shrinking regions in Germany, or places in macroeconomic crisis such as Greece or Spain. In this regard, the chapter aims to expose how political-economic and spatial context shapes sustainability challenges, and further, how examining the networked flows is likely a better assessment of sustainability problems than are evaluations of isolated place-based projects.

This argument lays at the intersection of several literatures on urban sustainable development. First, the study presented here challenges the assumption that "small is beautiful" that still underlies a lot of scholarship in urban sustainability (Wheeler and Beatley 2008). Following this paradigm, sustainability can be achieved through a formula of population density, the generating of walkable communities that bring people together, neighborhood greening, and technological innovation toward the reduction of fossil fuel consumption particularly in the transport and building sectors (Wheeler and Beatley 2008; Frey 2011). By some accounts, the formulas are also surprisingly overrationalized. Take, for example, Newman's (2014) calculation toward the improved provision of transit, walking, and cycling opportunities in town centers:

> A pedestrian catchment area, or 'ped-shed', based on a 10-minute walk, creates an area of approximately 10 000 resident and jobs within this 10-minutes walking area. […] If a walking city center is required, then a density of 100 per ha is needed. This gives an idea of the kind of activity that a town center would need: approximately 100 000 residents and jobs within this 10-minute walking area. […] Lower numbers than this means that services in a town center are non-viable […] This also means that the human design qualities of the center are compromised because of the need for excessive amounts of parking. (p. 20)

Others suggest, too, that to achieve sustainability, such central nodes of activity might be further networked along the tenants of Walter Christaller's central place theory (Knox and Mayer 2009), a strange reference indeed—perhaps for Europeans in particular—considering the frightening motivations behind his project of *Lebensraum* (Barnes and Minca 2013). Absent of analyses on, to name a few, the makeup of the labor force and employment possibilities, the provision of hospitals or schools, value chains of food

production, and the political economy of land use, these measurements and models are difficult to understand. Underlying these is a localism that has also been critiqued as a "local trap" (Born and Purcell 2006) and that overlooks the multi-scalar relations that contextualize place-based and well-meaning sustainability initiatives (Carr and Affolderbach 2014). This chapter presents the case of Luxembourg, which may seem beautiful and small, yet, hardly a textbook example of sustainable development. This conclusion is revealed upon examination of the social production and spatial arrangements of its networked flows that constitute it.

The second set of literature that is relevant here are the debates in policy mobilities that examine how policies are imported and exported. Recipe-oriented place-based sustainability or so-called best practices are a prime example of policies on the move, where policy-makers observe good ideas in one location and attempt to apply them within their own jurisdictions. Policy mobility debates expose that such attempts to transfer policies often overlook specific sociopolitical and economic conditions. That is, policies cannot merely be transferred from one locale and cookie-cut onto another locale elsewhere. Scholars of policy mobility have demonstrated, for example, that Business Improvement Districts and New Urbanism are not policy agendas that can simply be copied in different places with the hopes of achieving the same results (e.g., see McCann and Ward 2010; Peck and Theodore 2001): Context matters. Policy mobility scholars argue that context matters. The critique also applies to sustainable development policies. There now exists a vast palate of sustainability options ready for export. Scholars who have examined the mobility of sustainable development policies criticize that sustainability is not a simple formula that can be applied one-to-one from one place to another because, again, context matters: Local actors and institutions can intervene, modify, reinterpret policy formulations that obstruct policy importation and implementation (Temenos and McCann 2012; Carr 2013; McLean and Borén 2015).

The third relevant body of literature is the work that exposes the vast range of urban forms that exist today, and refers not only to the urban and suburban but also post suburban. Already, literature on suburbs (Burdack and Hesse 2007; Charmes and Keil 2015; Phelps and Wood 2011) revealed how urban spaces have diversified in recent decades, showing that processes of urbanization are changing and obliterating the classical town-country divide. Further, while scholars have identified a variety of suburb typologies such as "middle landscape" (Rowe 1991) or "Zwischenstadt" (Sieverts 2003), some observe now that the ways they are built, lived, and functionalized are so diverse that we can now speak of post suburbs. This signifies a move away from the idealized city center—and said relevant policy recipes—to "the explosion of the

city form" (Wachsmuth 2014, 75). In this context, Wachsmuth (2014) correctly challenges the "methodological cityism" of much sustainability policy:

> the prevailing model of urban sustainability is too narrow. Although the social, economic and ecological issues behind sustainability problems are regional or global in scale, urban policy usually addresses single ecological issues in individual neighbourhoods. Focusing on dense cities and their affluent areas ignores social movements and their advocacy for quality-of-life issues such as housing and commuting, which have direct ecological consequences. Targeting specific districts ignores the often negative regional and global impacts of local environmental, or 'greening', improvements. (Wachsmuth et al. 2016)

This critique is echoed in other research focusing on Europe (Carr and McDonough 2016), and, as the reader will see, the critique applies to Luxembourg as well, which is a small sovereign nation under growth pressure, and part and parcel to new post-suburban forms that are profoundly dependent on international and cross-borders flows. This emerging agglomeration reveals new challenges that demand new approaches to sustainability.

Case Study

The Grand Duchy of Luxembourg can be located tucked between Belgium, France, and Germany. With just over 2500 square kilometers, and housing just under 600,000 inhabitants, it can be classified as a small state. Recently, the nation has enjoyed a successful economic transition, achieved through downsizing its iron and steel industries and developing new economic niches. This transformation involved, first, attracting European institutions. Today, as the second European capital, Luxembourg hosts roughly 20 percent of the labor force that staff the administrative units of the European Union. Second, the Grand Duchy cultivated itself as a global financial center, now sitting in the top 20 financial markets in the world and fifth in Europe. The economic transition, third and most recently, involved marketing itself to global industries as a lucrative location to set up business. In this endeavor, Luxembourg focused on companies in the IT branch, attracting such companies as Amazon, PayPal, Google, and Skype/Microsoft, as well as companies in the space industry, expanding on its already resident *Société Européenne des Satellites* (SES) that operates a fleet of communication satellites. So far, Deep Space Industries and Planetary Resources, companies that concentrate on asteroid mining, have moved their European headquarters to the Grand Duchy. One

might say that this small state has given substantial attention to fortifying the economic pillar of sustainable development.

The net effect of these overall changes caused the inward migration of a multilingual and well-paid labor force as Luxembourg became a node of employment in the Greater Region. These changes also saw an increase in tax revenues that enabled the state to deliver on domestic welfare services and certain infrastructural investments. It is hotly debated, inside the nation, whether or not investments were appropriately targeted, but generally residents of Luxembourg have access to tuition-free public education, universal health and dental care, available unemployment and pension insurances, gratis transit for students and very inexpensive transit for everyone else (a year-long pass costs between 150 and 250 US dollars), new school buildings and classroom equipment/books, a new university, new roads, and public transit infrastructure. On the face of it, it would seem that this small state also gave substantial attention to fortifying—through investments in welfare—the social pillar of sustainable development as well.

The environmental pillar was also not entirely ignored either, particularly in the City of Luxembourg, the Grand Duchy's capital. New measures to address environmental issues include: (a) new bike lanes throughout the city, as well as bikes and electric car rental stations throughout the country; (b) improved building standards as all new buildings arriving on the market must be assessed and certified according to their energy efficiency; (c) climate change programming, as a number of municipalities in the Grand Duchy participate in the European Energy Awards system; and (d) expanded activist networks engaging in environmental awareness. Friends of the Earth Luxembourg (*Mouvement écologique, MECO*) is the most prominent address here. In recent years, it expanded its membership and programming and moved offices into a larger, state-of-the-art, ecologically friendly building in the heart of the City. Active in local environmental politics, MECO has become a central organization raising awareness of local environmental challenges such as uncontrolled development and biodiversity protection, alternative food production systems, supporting small businesses that sell environmental products (such as organic food or clothing production, environmentally friendly building, and building materials), and developing education programs to increase public outreach.

Luxembourg might be envied for these investments and changes, and admired for its apparent commitments to various dimensions of sustainable development. However, its development trajectory is characterized by several specificities that distinguish it from urban economic development elsewhere, some of which are far from sustainable. First, it took place in a rather short

period of time, generating by the mid-2000s the highest rate of relative resident population increases in the European Union (European Commission 2011), which put strain on existing infrastructures and institutions that were formerly designed for other purposes. Further, generating rather extreme daily fluctuations (relative to pre-existing capacities of the country), the City of Luxembourg's population nearly doubles in size as commuters from neighboring countries enter to work (Becker and Hesse 2010, 2). In 2016, Luxembourg housed more than 400,000 jobs, generating employment for both domestic residents and international commuters. The buying power of this new well-paid cohort combined with the benefits of an increased quality-of-life standard among existing residents boosted commerce and sent land prices through the roof, rendering it one of the most expensive places in Europe.

Second, these changes were not so much based on a continuous, endogenous development path but on the everlasting and necessary internationalization of the Grand Duchy: Strategic repositioning within international flows is nothing new in Luxembourg (!). Its steel industry was international, as were the systems of feudal land use under the monarchy before that. In the case of Luxembourg, its postwar protean strategies have been documented in its being at the forefront of building international relations such as Benelux, the EU, the Schengen Agreement, North Atlantic Treaty Organization (NATO), United Nations, and the Organisation for Economic Co-operation and Development (OECD). And, amidst the 2016 quakes of European disintegration pushed by antidemocratic populist movements in France, England, Germany, and Italy, Luxembourg was a voice in favor of continued international cooperation and stability. Unable to supply the human and natural resources needed to manage itself as a self-sustaining nation, Luxembourg has always looked abroad to cooperate internationally: this is the norm of a small state, and this dependence on international relations renders it into a kind of protean body that needs to maintain the skills that enable it to change rapidly in response to continually changing international conditions. In this sense, a small state can arguably never become complacent in believing that it has achieved sustainability—if the term "sustainability" is to invoke a sense of improvement that will last over time.

Third, the specific social spatial organization of these developments had particular impacts. So far, strategic developments have concentrated in specific locations across the country (mostly near the capital city) such as the plateau of *Kirchberg* that houses the European institutions and roughly 50 of the 144 banks operating in the nation or the office islands at the periphery of Luxembourg City (*Cloche d'Or* or Munsbach). There is also the emerging

research city (*Cité des Sciences*) located on a former industrial site of ArcelorMittal on the southern border to France. These nodes, the traffic conduits that connect them to each other, and the bedroom communities both inside the nation and beyond the national border, constitute what one might call the Luxembourg agglomeration: functional areas of increasing urbanization and increasing pressure for further building for housing and commercial development.

Changes in the agglomeration have put pressure on land use throughout the country as well as in the border regions of neighboring countries. Extraordinary high land prices compounded by minimal property taxes have promoted speculation. This and the profitability of renting office and retail spaces over lodging have increased housing pressure (lowering housing vacancies). Recent transformations have thus had socially polarizing effects, squeezing low wage earners out of the housing market, and igniting discourses about the possible benefits of providing lower-priced housing and diversifying neighborhoods, which have so far not come to fruition. Renters and home buyers have not only been displaced from the Luxembourg agglomeration but also from the nation as a whole, as lower-skilled labor and pensioners prefer to either settle in, or emigrate to, the bordering regions of Germany, France, or Belgium. This cross-national migration exacerbated needs for further cooperation to address cross-border issues; however, so far governing mismatches have only been exposed as the four countries reveal their differing practices of decision-making at their respective levels of government (Affolderbach 2013; Vidal and Niedermeyer 2011). What might be a concern for a national government on one side of the border might be a concern for a local authority on the other, for example. Further, increased migratory flows have increased commuter traffic and raised respective pressures on infrastructure—that is still organized, in the first instance, around the private car—aggravating socioeconomic and environmental justice problems as lower wage earners face longer commutes and less attractive tax benefits if living in the border regions.

It is recognized that there is a need to study these processes and find solutions to surfacing sociopolitical and environmental problems, and in recent years an array of institutions have emerged that address respective issues. There is, as indicated above, the network of organizations and community groups that voice concerns about preservation of biodiversity of the region, promoting local organic agriculture or environmental education for children, or raising awareness of some of the adverse environmental effects of domestic urbanization. MECO could be classified among these. There are also the municipalities that address local problems. At the level of the central government, the Ministry of Sustainable Development and Infrastructures (*Ministère*

du Développement durable et des Infrastructures, MDDI) is another prominent address, as it houses the Departments for the Environment, Transport, and Planning (respectively, these are the *Département de l'Environnement*, the *Département des transports*, and the *Département de l'aménagement du territoire*). Architectural firms and some companies in the construction industry could also be identified, as these are the institutions that deal with land use throughout the Grand Duchy, defining, driving, and negotiating through the political environmental economy thereof. There are competing visions for the nation throughout this array of institutions, but the overall general consensus is that landscapes should be protected, transport should be optimized, building intensified (e.g., through the mobilization of unused building plots onto the market) and concentrating development at certain growth poles, and arrangements of private property should be preserved. In this way, it is predicted that sustainable development will be achieved.

Contradictions in these responses can be identified that have, to date, rendered them ineffective. First, even if the approaches were acutely aware of the cross-national challenges associated with ongoing economic development, solutions were ultimately oriented and confined to existing domestic institutional arrangements that, unchallenged and closed to critique, were unlikely to achieve serious change. For example, approaches were born out of and confined to the two-level government structure, whereby the central government oversees 106 municipalities. In the name of local municipal autonomy, municipalities were in charge of defining land use and zoning; however, because they were also sparsely populated, they usually lacked the expertise needed for urban issues (such as construction works for infrastructure), and consequently contracted such work out to the highest bidder. Development was thus de facto entirely driven by private property, where landowners, developers, and particular politicians were the gatekeepers. To coordinate—or, in the case of Luxembourg, more likely, to control—development, municipalities were required to submit land-use plans to the central government for approval. This process was often observed as slow and ineffective, as approvals are often returned with conflicting directives from different ministries, demanding revisions and resubmissions. This left municipalities in limbo about where and whether they could build. It also cultivated reduced supply, maintaining high land values and associated problems.

Second, policy responses were ultimately bound to the national territory. Many of the local green initiatives exemplify this. While there is a vibrant community of activists interested in local change (Doerr and Carr 2014), few address wider interwoven international networks and flows. For some, it may seem counterintuitive to address concerns that lay beyond the national border.

Such an approach may also, for good reason, not be possible because such interventions, if they do not outright contravene international agreements, demand complex intergovernmental cooperation. Yet, those challenges across the agglomeration of Luxembourg are, indeed, cross-border. Serious attempts to address sustainability issues thus demand a macroanalysis that goes beyond national boundaries.

Lessons Learned

If one were to Google an image of Luxembourg City, one would likely see a beautiful old town set upon a hilltop and spilling down the hillside over its stunning seventeenth-century fortress walls into the valley below: It is the imagery of an almost stereotypical medieval European city. Not unlike some of the images presented in Knox and Mayer's (2009) book on small town sustainability, one would likely also view narrow streets, small shops, pedestrian zones, and plenty of trees. Appealing as this representation is, it is misleading because the City of Luxembourg is part of a larger agglomeration with respective flows and challenges that reflect actual development trends, and these are overlooked. This is a cross-border, multipolar, urban space.

There are a couple of immediate lessons learned here. First, small is not necessarily beautiful. Luxembourg is beautiful in the aesthetic sense, but its current patterns of development are not sustainable. Second, recipes for sustainability such as formulas for population densities or prescriptions for particular kinds of infrastructure developments (such as public cycling or pedestrian zones) cannot simply be transferred from one place to another. In the case of the Grand Duchy, these measures have arguably increased urbanization pressures and made socioeconomic problems worse because they did not address institutional contradictions or because they were localists in their social spatial orientation. Third, sustainability solutions need to address actual functional pathways and networked flows. That is, they need to address the current modes of social spatial urban production. The agglomeration of Luxembourg can be understood in light of recent scholarship that has reflected on post-suburban space (Charmes and Keil 2015; Phelps and Wood 2011). Just as Keil and Addie (2015) argued that the morphologies of Toronto and Chicago defy conventional city-suburbs nomenclatures, so too does the agglomeration of Luxembourg—a cross-border space of flows, spanning from island developments in and near the City of Luxembourg and spreading into France, Germany, and Belgium. This is a new kind of urban space, indicative of contemporary European post-suburbanization processes that are both

place-specific and path dependent. Developments across the agglomeration targeted higher-income labor cohorts leaving lower-income cohorts to settle in neighboring countries. Luxembourg, thus, not only provides the international literature with a new post-suburbia to struggle with, it also signals different kinds of sustainability challenges that require innovative approaches.

Challenges and Barriers

Design alone is not enough. Technical one-fix solutions to sustainability do not exist. Recipes for urban sustainability are likely to be misguided. Such claims seem bold in an era where urban transformation in Europe is led by profit-seeking development, and serious consideration for sustainability problems seems more urgent than ever. Yet, the case of Luxembourg sheds light on this because it shows that current sustainable development orthodoxies are insufficient. What is urgently needed is an examination of the winners and losers in development approaches: Who has financial power? Who profits? What are the resistance factors in fostering change? How are sociopolitical and economic dynamics spatially arranged? These questions, and others like them, address actors and institutions and scrutinize the range of contradictions and dilemmas therein.

With respect to Luxembourg, Hesse (2016) exposed the power dynamics involved in urban and regional sustainability planning: As a small state, Luxembourg developed itself as a political-economic niche embedded in wider networked international flows. Normative territorially bounded, place-based, sustainability policies that overlooked the realities of increasing global connectedness in such enclave spaces are unlikely to be effective. In this chapter, we assessed Luxembourg as a post-suburban agglomeration and arrived at similar conclusions. Overcoming these barriers ought to be put in the foreground. These include imagining cross-border solutions, moving beyond classic environmental orthodoxies such as densification, bringing new sets of stakeholders into the discussion (particularly disadvantaged groups), keeping pace with new conceptions of urban space, finding new models of economic organization, and addressing the underlying questions of how things might be improved in the coming decades. The answers to these questions are not found in sustainable development recipes, and the answers will vary depending on the context. These are the kinds of barriers that need to be addressed in order for there to be greater success toward sustainability.

Further Reading

Affolderbach, J. 2013. Negotiating Border Regions. Retail Development in Luxembourg and the Greater Region. In *Theorizing Borders*, ed. P. Gilles, H. Koff, C. Maganda, and C. Schulz. Brussels: P. I. E. Lang.

Affolderbach, J., and C. Carr. 2016. Blending Scales of Governance: Land-Use Policies and Practices in the Small State of Luxembourg. *Regional Studies* 50 (6): 944–955.

Barnes, T.J., and C. Minca. 2013. Nazi Spatial Theory: The Dark Geographies of Carl Schmitt and Walter Christaller. *Annals of the Association of American Geographers* 103 (3): 669–687.

Becker, T., and M. Hesse. 2010. Internationalisierung und Steuerung internationaler Wohnungsmärkte–das Beispiel Luxemburg. *Informationen zur Raumentwicklung* 5 (6): 403–415.

Born, B., and M. Purcell. 2006. Avoiding the Local Trap, Scale and Food Systems in Planning Research. *Journal of Planning Education and Research* 26 (2): 195–207.

Burdack, J., and M. Hesse. 2007. Suburbanisation, Suburbia and "Zwischenstadt": Perspectives of Research and Policy. In *Territorial Cohesion*, ed. D. Scholich, 81–100. Berlin: German Annual of Spatial Research and Policy.

Carr, C. 2013. Discourse Yes, Implementation Maybe: An Immobility and Paralysis of Sustainable Development Policy. *European Planning Studies* 22 (9): 1824–1840.

Carr, C., and J. Affolderbach. 2014. Rescaling Sustainability? Local Opportunities and Scalar Contradictions. *Local Environment: The International Journal of Justice and Sustainability* 19 (6): 567–571.

Carr, C., and E. McDonough. 2016. Integrative Planning of Post-Suburban Growth in the Glatt Valley (Switzerland). *Raumforschung und Raumordnung*. https://doi.org/10.1007/s13147-016-0403-x.

Carr, C., T. Becker, E. Evrard, B. Nienaber, U. Roos, E. McDonough, M. Hesse, and R. Krueger. 2015. Raising Sustainability/Mobilising Sustainability: Why European Sustainable Urban Development Initiatives Are Slow to Materialise/Territorial Cohesion as a Vehicle of Sustainability/Sustainable Urban Development and the Challenge of Global Air Transport Nodes and Spatial Integration/Distorted Density: Where Developers and Non-Governmental Organizations on Sustainable Urban Development Agree/Overcoming Politics with Markets? The Co-production of Sustainable Development in Urban and Regional Planning. *Planning Theory & Practice* 16 (1): 99–125.

Charmes, E., and R. Keil. 2015. The Politics of Post-Suburban Densification in Canada and France. *International Journal of Urban and Regional Research* 39 (3): 581–602.

Doerr, J., and C. Carr. 2014. Dreizig Jahre Transformation und trotzdem noch ganz am Anfang? Der Wandel in Beckerich von der Agenda 21 zur Transition Town. *Planung Neu Denken* 3: 1–7.

European Commission. 2011. *Demography Report 2010*. Luxembourg: Eurostat.
Frey, W. 2011. *Freiburg Green City: Approaches to Sustainable Urban Development*. Freiburg: Herder.
Hesse, M. 2016. On Borrowed Size, Flawed Urbanisation and Emerging Enclave Spaces: The Exceptional Urbanism of Luxembourg. *Luxembourg European Urban and Regional Studies* 23 (4): 541–555.
Keil, R., and J.D. Addie. 2015. It's Not Going to Be Suburban, It's Going to Be All Urban: Assembling Post-suburbia in the Toronto and Chicago Regions. *International Journal of Urban and Regional Research* 39 (5): 892–911.
Knox, P.L., and H. Mayer. 2009. *Small Town Sustainability: Economic, Social, and Environmental Innovation*. Basel: Birkhäuser.
Krueger, R., and D. Gibbs, eds. 2007. *The Sustainable Development Paradox: Urban Political Economy in the United States and Europe*. New York: The Guilford Press.
McCann, E., and K. Ward. 2010. Relationality/Territoriality: Toward a Conception of Cities in the World. *Geoforum* 41: 175–184.
McLean, B.L., and T. Borén. 2015. Barriers to Implementing Sustainability Locally: A Case Study of Policy Immobilities. *Local Environment* 20 (12): 1489–1506.
Newman, P. 2014. Rediscovering Compact Cities for Sustainable Development. In *Elgar Companion to Sustainable Cities: Strategies, Methods and Outlook*, ed. D.A. Mazmann and H. Blanco. Cheltenham: Edward Elgar.
Niedermeyer, M., and P. Moll. 2007. SaarLorLux – Vom Montandreieck Zur "Großregion". In *50 Jahre Saarland Im Wandel*, ed. H.P.P. Dörrenbächer, O. Kühne, and J.M.M. Wagner, 297–321. Saarbrücken: IfLiS.
Peck, J., and N. Theodore. 2001. Exporting Workfare/Importing Welfare-to-Work: Exploring the Politics of Third Way Policy Transfer. *Political Geography* 20 (4): 427–460.
Phelps, N.A., and A.M. Wood. 2011. The New Post-Suburban Politics? *Urban Studies* 48 (12): 2591–2610.
Rowe, P.G. 1991. *Making a Middle Landscape*. Cambridge: MIT Press.
Rydin, Y. 2010. *Governing for Sustainable Urban Development*. London: Earthscan.
Sieverts, T. 2003. *Cities Without Cities: An Interpretation of the Zwischenstadt*. London: Routledge.
Temenos, C., and E. McCann. 2012. The Local Politics of Policy Mobility: Learning, Persuasion, and the Production of a Municipal Sustainability Fix. *Environment and Planning A* 44 (6): 1389–1406.
Vidal, M., and M. Niedermeyer. 2011. Le Développement Territorial et sa Dimension Transfrontalière: Expériences Du Luxembourg et de la Grande Région. In *Raumordnung in Luxemburg / Aménagement Du Territoire Au Luxembourg*, ed. T. Chilla and C. Schulz, 296–316. Luxembourg: Binsfeld.
Wachsmuth, D. 2014. City as Ideology: Reconciling the Explosion of the City Form with the Tenacity of the City Concept. *Environment and Planning D* 32 (1): 75–90.
Wachsmuth, D., D.A. Cohen, and H. Angelo. 2016. Expand the Frontiers of Urban Sustainability. *Nature* 536: 391–393.
Wheeler, S.M., and T. Beatley. 2008. *Sustainable Urban Development Reader*. London: Routledge.

40

Florida's Growth Management Experience: From Top-Down Direction to Laissez Faire Land Use

Aaron Deslatte

Background

Managing urban land use and development poses challenging governance issues to state and local governments around the globe. Cities account for more than half of the world's population (UN 2012) and 70 percent of all greenhouse gas emissions contributing to climate change (IPCC 2014). Yet, efforts by local governments to manage growth through urban containment policy actions have proven controversial. Urban containment policies attempt to steer growth internally within a community while minimizing fiscal costs and negative interactions between land uses. Not only is there conflicting evidence of the impact of containment efforts in curbing inefficient sprawling development patterns, but containment has also been linked to social stratification and inequity (Dierwechter 2014). This presents fundamental challenges for understanding the containment actions available to local governments, their choices to employ them as a land-use and development strategy, and how patterns of urban containment differ across time in response to changes in the economy and state regulatory processes.

Florida provides an ideal case study of urban containment with a well-documented research record and substantial variation among state and local government growth management approaches. Florida was once viewed as an exemplar of progressive growth management in the United States. Since the

A. Deslatte (✉)
Department of Public Administration, Northern Illinois University, DeKalb, IL, USA

R. Brinkmann, S. J. Garren (eds.), *The Palgrave Handbook of Sustainability*,
https://doi.org/10.1007/978-3-319-71389-2_40

1970s, policymakers have employed evolving systems for requiring and coordinating growth planning to contain urban expansion and mitigate the negative externalities of urban sprawl and environmental degradation. The state's intergovernmental regulatory efforts culminated with legislation known as the Growth Management Act (GMA) in 1985, considered a pioneering attempt to steer growth down a more sustainable course. For more than two decades, local governments were required to maintain comprehensive plans for growth consistent with state and regional goals. Cities and counties set uniform level-of-service standards for water, sewer, solid waste, drainage, roads, and open space as well as mandates that roads and other facilities needed by new development be made available "concurrently" when the projects would go online (Ben-Zadok 2005; Chapin et al. 2007; Dawson 1995; DeGrove 2005). Policymakers paired state-level regulatory requirements for concurrent road, sewer, and park development with goals for compactness and consistency across jurisdictional lines (Ben-Zadok 2005). Meanwhile, local governments adopted a range of zoning, transportation, and environmental policy tools in an attempt to combat sprawling development patterns, traffic congestion, and natural resource degradation (Chapin 2007; Feiock and Tavares 2002; Feiock et al. 2008).

As a result, Florida's growth management policies have been the subject of substantial empirical research (Chapin et al. 2007), focused on problems with implementation (DeGrove and Turner 1998), political interference (deHaven-Smith 2000), and policy abandonment (Steiner 2001). Florida's unrelenting growth pressures have also been the subject of a stream of studies examining how institutional and interest group influences shape the political marketplace for land-use policies.

This perspective considers how growth management institutional arrangements are used to supply preferred development policies and provide certainty to land developers and other constituencies (Deslatte 2016). This research has examined the competing values of bureaucratic and political actors influencing land management (Deslatte et al. 2017), conservation policy tools (Feiock et al. 2008), and the balancing act within local governments between environmental public goods and development rights. Feiock et al. (2008) found evidence that the Florida county adoption of land-use tools including urban service boundaries, incentive zoning, impact fees, and transfers for development rights are associated with higher socio-economic populations and fiscal means. Ramirez de la Cruz (2009) found evidence that Florida cities were more likely to adopt density bonuses and smart-growth zoning than another tool with greater redistributive consequences, urban service boundaries, when concerns for urban sprawl were greater. Lubell et al. (2009) found mayor-led cities were more likely

to be responsive to wealthier residents who support conservation goals yet desire to build homes near natural amenities, degrading the resource. These findings collectively suggest that localities are engaging in a series of trade-offs between the job creation and growth forces within their borders and the wealthier (and possibly more environmentally concerned) residents.

One conclusion from these distinct research streams is that even within a coordinated, state-led growth management policy system—albeit, one undermined during implementation—local land-use policies remained highly malleable under competing pressures to protect Florida's scenic coastlines and natural resources while accommodating break-neck growth. Dissatisfied with results on the ground, public support for Florida's growth management regime receded as the state's population surpassed 18 million, its demographics became more racially and economically stratified, and metropolitan areas like Orlando, Tampa, and Miami were re-defined by exurban sprawl (Chapin and Connerly 2007). In 2011, the Florida Legislature and Governor Rick Scott enacted changes, abolishing the state's land-planning agency and effectively removing the state role in most local growth management decisions. This chapter examines local government policy actions related to Florida's growth management experience pre- and post-reform.

Case Study

Previously a sleepy, backwater locale, Florida began witnessing a deluge of population growth in the 1960s, spurred by air conditioning, expressways, the lack of a personal income tax, and higher incomes for retirees (deHaven-Smith 2000). The state's population in 1970 had reached 6.7 million and surpassed 20 million by 2016.[1] Population encroachment and development of wetlands depleted aquifers, degraded water systems such as the Everglades, and pushed many species such as manatees and Florida panther to the brink of extinction. At the same time, Florida has maintained some of the more stringent property tax limitations in the United States and remains one of only seven states without an income tax. Florida's heightened reliance on sales tax—a benefit when the state was primarily a seasonal tourist retreat—rendered both state and local government budgets more vulnerable to economic turbulence (deHaven-Smith 2000). Efforts to address these problems culminated in the mid-1980s and early 1990s with sweeping changes to land-use and growth management intergovernmental regulations.

Florida's regulatory approach centered on comprehensive planning at the local, regional, and state level in order to coordinate land uses and the spatial

distribution of growth, contain urban sprawl, and protect unique, environmentally pristine wetlands, agricultural operations, and coastal ecosystems (Ben-Zadok 2005). For local governments, the state-level policy interventions have had a marketed impact on how cities and counties plan for future development. Florida growth planning in general has evolved from a period of "first-generation" top-down regulation and strict limits to more incentive-structured comprehensive planning and "smart-growth" eras through the early 2000s (Chapin 2012; Daniels 2001). In 2011, Florida's local governments were delegated far greater control over their future land uses.

State-Level Policy Evolution

From the onset, Florida's state policies have been historically plagued by political interference and implementation problems. Governmental efforts began in earnest in the 1970s to address the mismatch between the tax limitations of local governments and the challenges to wildlife habitat and water quality and quantity, regional sprawl, and urban blight (DeGrove 1984, 2005; DeGrove and Turner 1998). These efforts were intended to develop a cohesive system and state, regional, and local comprehensive planning, a process for reviewing major projects which impacted more than one county, such as planned communities, airports, or shopping malls, and a program for protecting areas of the state where land development would impair critical environmental resources (Pelham 1979). These efforts began with the passage of the Environmental Land and Water Management Act of 1972 which provided for new oversight of Developments of Regional Impact (DRI) and the designation of "critical areas" for protection. The same year, lawmakers also passed the Florida State Comprehensive Planning Act directing state administrators to develop a plan providing long-range guidance to local governments, although lawmakers subsequently refused to adopt the final state plan in 1980. While local growth planning was made mandatory under the Local Government Comprehensive Planning Act of 1975, no consistency requirements guided their development and no enforcement mechanisms were included to control the substance of the plans. The effort had the effect of legitimizing comprehensive plans which merely incorporated existing development patterns.[2]

While lacking clear state direction under its 1970s-era regulatory framework, Florida policymakers revisited the problem beginning with a new study committee created in 1982 by Democratic Governor Bob Graham. The effort convinced lawmakers to authorize a stronger State Comprehensive Plan in 1984 and to pass a sweeping package of legislation in 1985 which came to be

known as the GMA. The GMA was intended to coordinate implementation through the policies of consistency between local, regional, and state plans, compact development restraining sprawl, and the more-or-less concurrent provision of infrastructure to accommodate new development (Ben-Zadok 2005). State and regional comprehensive growth plans were required, local governments would need to make their own plans consistent with these state and regional plans, and the state Department of Community Affairs (DCA) was authorized to determine whether local plans were compliant. Noncompliance could cost cities and counties vital revenue sharing. To meet these standards, local governments would need to collect new data on traffic levels, water consumption, and land-use inventories, as well as including an element in their comprehensive plans to establish levels of service (LOS) standards for roadways and other fixed-capital investments. This way, local governments would be provided with clear state guidance on how to plan for future growth, a consistent framework for resolving land disputes between localities, and the "teeth" to deny development when infrastructure and tax revenues would not support its detrimental impact (O'Connell 1986). To pay for the impact, the state legislature voted in 1987 to extend its sales tax to legal, advertising, medical, banking, and other services.

However, shortly after these combined efforts were passed, impacted industry groups began applying pressure to have the reforms weakened. Fearing a voter backlash, the Republican Governor at the time, Bob Martinez, and legislators reversed course in a December 1987 special session by repealing the services tax, replacing it with a general sales tax hike (dehaven-Smith 2000). Meanwhile, the State Comprehensive Plan was weakened to make enforcement of anti-sprawl provisions such as urban growth boundaries unworkable for the state DCA, which was charged with overseeing the enforcement. The GMA was also amended in 1986—one year after its passage—to clarify that local governments would set acceptable Levels of Service (LOS) only for public facilities they directly oversaw. The same effort limited which types of facilities fell under the rule, effectively exempting local governments from applying the rules to schools, hospitals, jails, libraries, and other facilities. Florida's growth management system also sparked intense political fights between developers and local governments because of the disproportionate way it divided the costs of new development between existing and new development projects. Essentially, developers proposing new projects could be faced with impact fees which forced them to offset the impacts of traffic caused by prior developments. The transportation "concurrency" requirement generated negative spillover effects by making it prohibitively costly for infill and redevelopment to occur within the blighted bellies of larger cities like Miami, leading

lawmakers to change level-of-service standards in 1992, 1993, and 1999 to try and stem a development exodus to sprawling, unincorporated areas (Kim et al. 2014).

Florida grappled through much of the 1990s and early 2000s with the sprawling realities of the land-use policies which now effectively steered growth to the exurbs and the lack of adequate tax revenues to offset the impacts of rapid population growth. One exception came in 2005 at the peak of the mid-2000 housing boom, when Republican Governor Jeb Bush and legislators appropriated $1.5 billion for its infrastructure backlog and more stringent requirements for local governments to link development more closely to provision of adequate water, schools, park space, and roadways.

It was a renewed state focus that would not last. Within six years of the 2005 reforms, Florida policymakers and the development community were ready for a massive shake-up. The Great Recession and election of a new governor with no previous experience in government opened a window for fundamental changes in Florida's growth management laws. The legislature for the first time in more than a century comprised super majorities of Republican lawmakers, and construction and real estate activity slowed to a crawl by the time Rick Scott was elected in November 2010. Scott, a former healthcare Executive from Texas who self-financed $73 million of his own campaign, labeled DCA a "job killer" during his campaign and made good on a pledge to abolish the agency during the spring 2011 session. New presiding officers in the Florida House and Senate also responded to the housing slowdown by making major changes not just to the agency overseeing land use but the rules local governments and developers were to follow.

Largely written by development lobbyists, HB 7207 repealed the administrative rule that governed state review of local comprehensive planning, 9J-5, and streamlined growth management regulations by eliminating state-mandated concurrency for roads and schools as well as other provisions of the law (Deslatte 2011). Along with the rule, the state regulators were prohibited from rejecting amendments where they determined there was no demonstrated population need or projects which had not demonstrated financial feasibility. With land-planning oversight consolidated into a new Department of Economic Opportunity (DEO), the bill limited the time the agency had to review comprehensive plan amendments and barred regulators from objecting to most amendments unless they impacted "state resources or facilities." DRI reviews were also eliminated for a wide array of job-producing uses.

Finally, citizen participation in the planning process was substantially curtailed. The new Division of Community Planning within DEO saw its planning staff cut from approximately 60 under the old DCA to 30 full-

time employees under the new regime (Deslatte 2011). Along with a smaller staff, the division was no longer required to issue an Objections, Recommendations, and Comments (ORC) report for each proposed large-scale amendment. In the past, ORC reports were the primary means by which citizens who lacked access to professional planning staff were able to determine the impact of proposed local plan amendments. The division was also prohibited from intervening when the public challenged an amendment, shifting the responsibility for bringing a legal challenge solely to citizens. Local governments were also forbidden from allowing or requiring referenda for plan amendments.

Many local planning attorneys, Republican policymakers, and developers defended the 2011 about-face in state-planning philosophy as a necessary evolution to remove complex and overlapping planning requirements that were slowing economic recovery. They argued that cities and counties had bolstered expert planning staffs in-house during the previous two decades and could function without the state looking over their shoulder. Removing state planning could even allow for more creativity and collaboration in meeting diverse community goals, some proponents argued. But environmentalists and other planning experts called the reform the work product of profit-maximizing developers who had little regard for long-term environmental and collective-action consequences. Foremost among the critics was Thomas Pelham, a St. Petersburg land-use lawyer who twice served as DCA Secretary under Governors Martinez (1987–1991) and Charlie Crist (2007–2011). Pelham resigned the day Scott was sworn into office and wrote that the 2011 reform was "radical, extremely unbalanced, and poorly drafted and vetted legislation that undermines planning and growth management for the benefit of special development interests" (Pelham 2011).

Local Government Land-Use Policy Tools

Florida's local governments have emerged to a new regulatory landscape as a result of the 2011 reforms. To provide a snapshot into local government land-use activities, Florida cities were surveyed in 2002, 2007, and 2015 to assess variation in land-use policy tool utilization rates pre- and post-reform as well as identifying any correlation between these land-use policies. Zoning reflects the police power local governments in the United States wield to promote public welfare by dividing land into districts (zones) and imposing different land-use controls in these zones. Zoning tools may be designed to accommodate development by promising greater densities per parcel for developers

willing to invest in blighted areas or provide public amenities. Or they may be more coercive to prohibit unwanted activities or externalities, such as urban service boundaries, which render it impractical for development outside an identified municipal geography (Ramirez de la Cruz 2009). They may also be designed in a less top-down regulatory fashion in order to incentivize more sustainable land uses (Chapin 2012). Research at the national level suggests that containment efforts also have impacts on housing prices, giving rise to fears of gentrification and racial/ethnic and income stratification, as well as posing public health problems by increasing drive/commute times and reducing physical exercise, among other health concerns (Anacker 2010; Berry 2001; Nelson et al. 2007).

The surveys each asked the senior planning official in each jurisdiction "[w]hich of the following Land Use Management Techniques have been used by your jurisdiction in the last 24 months?" The tools included mixed-use development; incentive zoning; historic district ordinance; floodplain zoning; large lot zoning; open space zoning; public use land acquisition; performance zoning; zero lot line housing; transfer of development rights; conservation ordinances; cluster development; and impact fees. These policy tools represent a variety of conservation and smart-growth approaches employed to preserve open spaces or steer development into more compact, contiguous patterns to minimize Florida's historic pattern of urban sprawl which has led to many of its environmental and quality-of-life concerns. The responses indicate that smart-growth land-use tools were more heavily utilized during the economic boom period in which the 2007 survey was administered. Cities turned to a wider array of land-use tools in 2007 than in either the periods preceding or following it. The results also indicate that Florida's historical pattern of underfunding infrastructure contributed to distributional conflicts at the local level. Utilization rates for the three surveys are reported in Table 40.1.

The 2002 survey was mailed to growth management and planning directors for 403 Florida cities, with a response rate of 80 percent. Respondents reported that the most utilized tool was impact fees (57 percent), mixed-use zoning (53.8 percent), and historic preservation zoning ordinances (30.7 percent). No other land-use technique was utilized by more than 30 percent within the prior 24 months. This suggests cities did not develop more diversified smart-growth approaches until the housing boom later in the decade.

In particular, heavy reliance on impact fees charged to developers is evident, a product of the intergovernmental failure to adequately finance the capital improvements required under Florida's concurrency mandate on local governments. Impact fees have been often considered a smart-growth

Table 40.1 Policy tool utilization rates

	2002	2007	2015
Incentive zoning	21.00%	78.20%	26.80%
Mixed use	53.80%	26.60%	66.90%
Historic preservation	30.70%	65.40%	34.40%
Floodplain zoning	23.10%	53.30%	60.80%
Large lot zoning	11.80%	72.40%	25.00%
Open space zoning	15.10%	64.40%	42.30%
Public land acquisition	22.60%	50.50%	44.50%
Performance zoning	8.70%	82.80%	17.00%
Zero lot line housing	28.50%	65.90%	28.80%
Transfer of development rights	5.90%	83.70%	9.20%
Conservation ordinance	26.90%	89.10%	9.20%
Cluster development	24.10%	61.80%	22.90%
Impact fees	57.00%	12.40%	14.4%

incentive rather than a top-down regulation because municipalities only require developers to contribute to infrastructure enhancement when they directly contribute to the stress on public works and infrastructure. However, their utilization by Florida counties and cities began in the early 1960s as a way to shift funding requirements for roads, sewers, and other infrastructure from the general population of local governments to the development industry (Juergensmeyer 2008).

Florida became known as a battleground for impact-fee use thanks to decades of litigation from road contractors, home builders, and other construction-related industries and groups over their constitutionality and application (Marshall and Rothenberg 2008). At the same time, the state's historic failure to address long-standing deficiencies in transportation infrastructure promised when the 1985 GMA was adopted led to a widely recognized backlog in meeting service standards in many locations, prompting higher utilization of impact fees in many localities (Chapin et al. 2007; deHaven-Smith 2000). As part of the 2005 growth management reform, school concurrency became mandatory and local governments were required to develop "proportionate fair share mitigation" ordinances which allowed developers to pay their "fair share" of the impacts on transportation and school systems rather than compensating for prior backlogs. From 2006 to 2009, the Florida Legislature developed state-wide "enabling legislation" to standardize the tests for whether impact fees were being utilized exclusively to finance new development rather than paying for backlogs of infrastructure projects. These statutory changes appear to have contributed to a dampening effect on impact-fee use. The 2007 survey (mailed to 405 cities, 56 percent

response rate) found the use of impact fees had declined to 12.4 percent. Another contributory factor may have been wider use of smart-growth zoning which may have shifted some development pressure to preferred locations where infrastructure was available.

The 2007 survey also found higher rates of utilization for 11 of the 13 policy tools displayed in Table 40.1. Transfer of development rights (83.7 percent) and performance zoning (82.8 percent) showed the largest percentage-point increase in utilization over 2002. Both of these approaches represent technical attempts to channel development pressure away from locales where it would be most detrimental to the productive agricultural, forest, and wildlife habitat of other environmentally sensitive lands in a city. TDRs designate "sending areas" where communities want less development and "receiving areas" where more intensive land uses may be permitted. Development rights are then transferred from sending to receiving areas. Meanwhile, performance zoning replaces traditional district-based zoning with performance standards for energy use, wastewater, and types of housing developed, while steering pressure away from floodplains, wetlands, and other less suitable locations. While neither represent classically coercive regulatory prohibitions against any development, they do impose higher technical skill requirements on municipal staffs and likely add time and expense to development projects. It follows that these tools would become more popularized in periods of heightened development pressure. In 2007, Florida was at the apex of its housing boom. The heightened demand for developable land during this period also could explain the popularization of land-use tools such as conservation ordinances (89.1 percent) designed to stave off development and incentive zoning (78.2 percent) intended to maximize existing space by offering density bonuses or provide public benefits such as affordable housing or green spaces.

The 2015 survey was sent online and via mail to senior planning officials in 410 cities, for a response rate of 42 percent. This survey suggests land-management techniques returning to something akin to their pre-boom rates of utilization. Compared to 2007, respondents reported declines in utilization for 10 of the 13 policy tools. Only mixed-use (66.9 percent) and floodplain zoning (60.8 percent) were utilized by a majority of the municipalities responding. The largest declines were for conservation (−79.9 percentage points) and TDR (−74.5 percentage points) tools, lending some support to the political market expectation that these tools would become more valuable to particular policy demanders during heightened periods of economic expansion and development pressure.

The 2011 reform allowed local governments to opt out of the requirements for providing roads and other infrastructure more or less concurrently with new development. Approximately 21 percent of cities responding to the 2015 survey indicated they have considered repealing their concurrency requirements for parks and recreation as well as transportation. Cities on average reported no change in their level of support for economic development and conservation before and after the changes.

Are the changes in policy tool utilization significant? Given the non-normality of the binary response variables for the tools, a nonparametric statistical test was used to provide evidence that the distributions of policy choices significantly differ across time periods. Differences in the proportions of the underlying distributions were tested with the Wilcoxon-Mann-Whitney rank-sum tests for each policy tool. The nonparametric procedure tests whether the change across two time periods is unlikely to be a random anomaly. In the comparisons of 2002–2007, all 13 policy tools demonstrated evidence of significant differences between the two time periods. In the 2007–2015 comparison, the tests find evidence that 11 of the 13 tools are significantly different, while in the comparison of 2002–2015 found that 8 of 13 were significantly different. Intuitively, this suggests the 2002 and 2015 survey respondents' choices are more alike than either are with 2007. To assess the overall survey bundle of tools, a multivariate analysis of variance (MANOVA) was also performed, which found the mean differences between all the "groups" statistically significant. We find this presents adequate evidence that the differences in utilization between survey periods is significant (Table 40.2).

Table 40.2 Wilcoxon-Mann-Whitney test for difference in distributions of samples

	H: 2002–2007	H: 2007–2015	H: 2002–2015
Incentive zoning	−10.92 (.000)**	9.36 (.000)**	−1.26 (.209)
Mixed use	5.5 (.000)**	−7.7 (.000)**	−2.48 (.013)*
Historic preservation	−6.72 (.000)**	5.73 (.000)**	−0.74 (.46)
Floodplain zoning	−5.96 (.000)**	−1.39 (.164)	−7.08 (.000)**
Large lot zoning	−11.66 (.000)**	8.53 (.000)**	−3.15 (.002)**
Open space zoning	−9.62 (.000)**	4.03 (.000)**	−5.62 (.000)**
Public land acquisition	−5.58 (.000)**	1.11 (.269)	−4.3 (.000)**
Performance zoning	−14.02 (.000)**	11.79 (.000)**	−2.31 (.021)*
Zero lot line housing	−7.12 (.000)**	6.71 (.000)**	−0.05 (.958)
Transfer of develop. rights	−14.93 (.000)**	13.51 (.000)**	−1.13 (.257)
Conservation ordinance	−11.89 (.000)**	14.38 (.000)**	4.12 (.000)**
Cluster development	−7.28 (.000)**	7.11 (.000)**	.257 (.798)
Impact fees	9.47 (.000)**	−11.99 (.000)**	−3.17 (.002)**

Note: Z-score reported (Prob >|*z*|)
*$p < .05$; ** $p < .01$

Lessons Learned

Political combatants in land use have contradictory objectives, because growth management decisions are inherently distributional in nature. Development interests seek profits, environmental or neighborhood activists seek protection of the environment or exclusion of outsiders, and policymakers interested in smart-growth principles attempt to satisfy a multiplicity of interests with often unforeseen consequences (Clingermayer 2004; Molotch 1976). Florida's growth management experience reflects seemingly incompatible impulses to maintain its image as a low-tax destination for retirees and businesses, power its economic engine via population gains and low-density development, while periodically acknowledging the central role that environmental resources play in its desirability to new residents and employers.

One lesson from Florida's experience is that state-led growth-control initiatives may be no more successful than local efforts to forestall the growth machine. A strong central role for the state in local land use was justified in the 1970s because local political institutions were deemed too weak to resist the development pressures driving environmental degradation and sprawl. Ironically, the multi-decadal effort to implement state growth management mandates encountered its own bumpy ride. Regulatory intentions were often stymied or weakened by legislators and governors fearful of voter backlash or Florida's powerful coalition of realtors, home builders, community developers, road contractors, and other development interests. As a result, Florida has continued to struggle with worsening traffic and sprawl as the Orlando and Tampa metropolitan areas continue to fuse along Interstate 4. Water management challenges have resulted in permanent use restrictions in places like South Florida. And rampant over-building of sprawling development in unincorporated areas or through special community development districts outside of municipalities has persisted through the housing bubble collapse and recession of 2007–2009.

Florida's state implementation problems have also plagued local governments. Survey data suggest Florida cities have returned to a "business as usual" post-recession, with a few exceptions. City reliance on impact fees to finance infrastructure has declined and will likely remain low now that the state has made the transportation concurrency mandate optional.

Mixed-use zoning remains the tool of choice for cities attempting to reintroduce a combination of commercial and residential uses within the same neighborhoods and development projects. Large lot and open space zoning, or zero lot-line housing, remain more common than zoning policies aimed at

addressing social inequities. Large-lot zoning is often used to limit development densities and preserve the rural, agricultural, or environmental character of communities by requiring mandatory-minimum acreages for residential dwellings. Suburban or rural communities seeking to "fend off" the encroaching urban densities of central cities adopted large-lot zoning in the 1950s and 1960s (Schoenbrod 1969). The policy has been criticized over concerns about race or income-based exclusionary purposes as well as its failure ultimately to prevent land from being subdivided into smaller units for development.

Open space zoning use remains higher, representing a "middle-ground" tool which aims to focus less on individual housing units and more on the larger development patterns of neighborhoods—allowing for denser development in areas or a larger tract of land in exchange for preserving rural or environmentally sensitive attributes on another section of the acreage.

Florida has witnessed a marked decline in the use of incentive zoning from the 2007 and 2015 survey periods Incentive zoning tools offer developers greater density "bonuses" (such as additional housing units per acre) in exchange for providing some types of community benefit such as affordable housing units or public park space. These efforts were attempts to reverse the effects of the sprawling and stratified suburban development that occurred post-World War II.

Lastly, municipalities also reduced their use of conservation zoning ordinances or hybrid approaches intended to prevent urban uses on pristine lands or those with larger ecosystems or natural resource protection value, such as water-recharge areas or threatened species habitat. The use of transfer of development rights programs in which housing construction rights are re-located to more development-friendly locations fell from a peak of 83.7 percent in 2007 to 9.2 percent in 2015. Such programs are intended to allow for the creation of greater conservation easements or rights on would-be preserved lands without diminishing the asset value of landowners who may seek to develop their property into higher uses. Local government utilization of more- or less-inclusive land-use tools may be a cyclical process, and the results indicate that Florida cities expanded their "tool box" during a peak period of demand for developable land.

Challenges and Barriers

It remains to be seen whether Florida's return to a more laissez faire approach to community planning will fulfill the promises of large landowners or the dire predictions of detractors. But Florida has made a major shift from

top-down coercive action to local control. Questions of whether regional or polycentric governance arrangements are superior for managing growth have held a central role in the urban literature (Howell-Moroney 2007, 2008). With historical growth rates not expected to return to pre-2007 levels for decades, Florida local government's experiences before and after these reforms can demonstrate whether the new rules for the road will lead to better policy outcomes.

Many salient questions remain. One involves the counter-factual. What would have happened had Florida never enacted its state oversight? Did the state system of coordination lead to increased planning capacities for managing growth at the local and regional level? Did it contain or spur discontinuous, sprawling land-use patterns? Land-management tools intended to stave off development may need to be carefully examined apart from "smart-growth" tools whose users make the key assumption that growth is inevitable and its spatial implications for resource use, quality of life, and inter-generational equity must be considered holistically. Since land-use management instruments have not been examined longitudinally, future research should explore these dynamics.

A larger question is, how do land-use policies of individual local governments influence the broader sustainability or urban regions? With some exceptions, political economies for policy tools are rarely examined over extended periods of time (Yi and Feiock 2014). Ultimately, this could allow for the examination of how commitment to sustainability in land use (something local governments in the United States have engaged in for half a century) influences the willingness to make other sustainability commitments, such as reducing carbon footprints. Unraveling these questions will be key to understanding how local governments in the United States and internationally confront the next half century of rapid urbanization.

Notes

1. Florida Legislature Office of Economic and Demographic Research: http://edr.state.fl.us/Content/population-demographics/data/CountyPopulation_2016.pdf.
2. Carriker, Roy R. "Comprehensive Planning for Growth Management in Florida," EDIS document FE642, Food and Resource Economics Department, Florida Cooperative Extension Service, Institute of Food and Agricultural Sciences, University of Florida, http://ufdcimages.uflib.ufl.edu/IR/00/00/13/51/00001/FE64200.pdf.

References

Anacker, Katrine B. 2010. Still Paying the Race Tax? Analyzing Property Values in Homogeneous and Mixed-Race Suburbs. *Journal of Urban Affairs* 31 (1): 55–77.

Ben-Zadok, Efraim. 2005. Consistency, Concurrency and Compact Development: Three Faces of Growth Management Implementation in Florida. *Urban Studies* 42 (12): 2167–2190.

Berry, Christopher. 2001. Land Use Regulation and Residential Segregation: Does Zoning Matter? *American Law and Economics Review* 3 (2): 251–274.

Chapin, Timothy S. 2007. Local Governments as Policy Entrepreneurs. *Urban Affairs Review* 4 (4): 505–532.

Chapin, Timothy. 2012. From Growth Controls, to Comprehensive Planning, to Smart Growth: Planning's Emerging Fourth Wave. *Journal of the American Planning Association* 78 (1): 5–15.

Chapin, Timothy S., and Charles E. Connerly. 2007. Attitudes Towards Growth Management in Florida: Comparing Resident Support in 1985 and 2001. In *Growth Management in Florida: Planning for Paradise*, 67–81.

Chapin, Timothy S., John I. Carruthers, and Harrison T. Higgins. 2007. *Growth Management in Florida: Planning for Paradise*. Burlington: Ashgate Publishing Co.

Clingermayer, James C. 2004. Heresthetics and Happenstance: Intentional and Unintentional Exclusionary Impacts of the Zoning Decision-Making Process. *Urban Studies* 41 (2): 377–388.

Connerly, C.E., T.S. Chapin, and H.T. Higgins, eds. 2007. *Growth Management in Florida: Planning for Paradise*. Farnham: Ashgate Publishing.

Daniels, Tom. 2001. Smart Growth: A New American Approach to Regional Planning. *Planning Practice and Research* 16 (3–4): 271–279.

Dawson, Mary. 1995. The Best Laid Plans: The Rise and Fall of Growth Management in Florida. *Journal of Land Use and Environmental Law* 11: 325–325.

DeGrove, John M. 1984. *Land Growth and Politics*. Chicago: American Planning Association.

DeGrove, J. 2005. *Planning Policy and Politics: Smart Growth and the States*. Cambridge, MA: Lincoln Institute of Land Policy.

DeGrove, J.M., and R. Turner. 1998. Local Government: Coping with Massive and Sustained Growth. In *Government and Politics in Florida*, ed. R.J. Huckshorn, 169–192. Gainesville: University Press of Florida.

DeHaven-Smith, Lance. 2000. Facing Up to the Political Realities of Growth Management. *Florida Planning* 7 (5): 14–17.

Deslatte, A. 2011. Developers Helped GOP Gut Florida's Growth Act, Records Show. *Orlando Sentinel*, September 4, pp. 1. Available at: http://articles.orlandosentinel.com/2011-0904/news/os-growth-management-gutting-20110904_1_billy-buzzett-growth management-growth-act.

———. 2016. Boundaries and Speed Bumps: The Role of Modernized Counties Managing Growth in the Fragmented Metropolis. *Urban Affairs Review*. https://doi.org/10.1177/1078087416655401.

Deslatte, A., W.L. Swann, and R.C. Feiock. 2017. Three Sides of the Same Coin? A Bayesian Analysis of Strategic Management, Comprehensive Planning, and Inclusionary Values in Land Use. *Journal of Public Administration Research and Theory* 27 (3): 415–432.

Dierwechter, Yonn. 2014. The Spaces that Smart Growth Makes: Sustainability, Segregation, and Residential Change Across Greater Seattle. *Urban Geography* 35 (5): 691–714.

Feiock, Richard C., and Antonio Tavares. 2002. County Government Institutions and Local Land Regulation. In *Analysis of Local Land Markets and the Impact of Market Regulations*, ed. Paul Cheshire and Stephen Sheppard. Cambridge: Lincoln Land Institute.

Feiock, Richard C., Antonio F. Tavares, and Mark Lubell. 2008. Policy Instrument Choices for Growth Management and Land Use Regulation. *The Policy Studies Journal* 36 (3): 461–480.

Howell-Moroney, Michael. 2007. Studying the Effects of the Intensity of the U.S. State Growth Management Approaches on Land Development Outcomes. *Urban Studies* 44 (11): 2163–2178.

———. 2008. A Mixed Method Look at State Growth Management Policy. *The American Review of Public Administration* 38 (3): 339–361.

IPCC. 2014. *Intergovernmental Panel on Climate Change Working Group III Contribution to Fifth Assessment Report*. United Nations, New York: IPCC.

Juergensmeyer, Julian Conrad. 2008. Infrastructure and the Law: Florida's Past, Present and Future. *Journal of Land Use* 23: 441–458.

Kim, Jeongseob, Ruth L. Steiner, and Yizhao Yang. 2014. The Evolution of Transportation Concurrency and Urban Development Pattern in Miami-Dade County, Florida. *Urban Affairs Review* 50 (5): 672–701.

Lubell, M., R.C. Feiock, D. La Cruz, and E.E. Ramirez. 2009. Local Institutions and the Politics of Urban Growth. *American Journal of Political Science* 53 (3): 649–665.

Marshall, J. Michael, and Mark A. Rothenberg. 2008. An Analysis of Affordable/Work-Force Housing Initiatives and Their Legality in the State of Florida. *The Florida Bar Journal* 82 (6): 53–59.

Molotch, Harvey. 1976. The City as Growth Machine: Toward a Political Economy of Place. *American Journal of Sociology* 82 (2): 309–332.

Nelson, Arthur C., Casey J. Dawkins, and Thomas W. Sanchez. 2007. *The Social Impacts of Urban Containment*. Hampshire: Ashgate Publishing.

O'Connell, Daniel W. 1986. New Directions in State Legislation: The Florida Growth Management Act and State Comprehensive Plan. In *Perspectives on*

Florida's Growth Management Act of 1985, ed. John M. DeGrove and Julian Conrad Juergensmeyer. Boston: Lincoln Institute of Land Policy.

Pelham, Thomas G. 1979. *State Land-Use Planning and Regulation*. Lexington: Lexington Books.

Pelham, Thomas. 2011. Florida Comprehensive Planning System Encounters Stormy Weather. *American Bar Association, Section of State and Local Government Law, State and Local Law News* 3 (Summer): 1–15.

Ramirez de la Cruz, Edgar E. 2009. Local Political Institutions and Smart Growth: An Empirical Study of the Politics of Compact Development. *Urban Affairs Review* 45 (2): 218–246.

Schoenbrod, David S. 1969. Large Lot Zoning. *The Yale Law Journal* 78 (8): 1418–1441.

Steiner, R. 2001. Florida's Transportation Concurrency: Are the Current Tools Adequate to Meet the Need for Coordinated Land Use and Transportation Planning? *Florida Journal of Law and Public Policy* 12: 269–297.

United Nations. 2012. *2012 World Urbanization Prospects: The 2011 Revision No. ESA/P/WP.224*. New York: United Nations.

Yi, Hongtao, and Richard Feiock. 2014. Renewable Energy Politics: Policy Typologies, Policy Tools, and State Deployment of Renewables. *Policy Studies Journal* 42 (3): 391–415.

41

Planning for City Sustainability: GreenWorks Orlando Case Study

Christopher V. Hawkins

Background

Cities are increasingly tackling climate change and broader urban sustainability issues. Recent studies indicate, for example, that approximately 60 percent of US cities with populations over 50,000 now have explicit sustainability efforts or initiatives (Krause et al. 2016). The notable uptick in commitment to and investments in environmental sustainability has shifted the focus of research and practice toward long-term planning for sustainability, organizational and administrative structures, and the implementation and management of local initiatives (Wang et al. 2012; Hawkins et al. 2016; Wang et al. 2017).

Research on local sustainability initiatives is quite varied. For example, studies have used the number and diversity of policy initiatives as indicators of cities "taking sustainability seriously" (Portney 2013). Other studies examine the human capital, financial resources, and organizational structures that are necessary for the successful design and implementation of these initiatives (Krause et al. 2016; Hawkins et al. 2016). Another stream of research, from which this case study draws from, emphasizes the role of city plans and policy documents (Conroy 2006).

Planning occurs primarily at the local level. Cities hold extensive authority to determine and regulate land uses and apply enforcement mechanisms to ensure compliance. In many cities, the plans in which sustainability-relevant

C. V. Hawkins (✉)
School of Public Administration, University of Central Florida, Orlando, FL, USA

R. Brinkmann, S. J. Garren (eds.), *The Palgrave Handbook of Sustainability*,
https://doi.org/10.1007/978-3-319-71389-2_41

goals and objectives are embedded, especially land use plans, are legally binding. And because they are typically approved by elected officials, planning goals and policies reflect a degree of political commitment. Moreover, long-range land use, transportation, housing, and economic development policies can have significant implications for the timing, location, and characteristics of future growth. The commitment to sustainability through plans aimed at guiding city growth patterns, energy consumption and production, and the allocation of public resources for economic, environmental, and social objectives thus can have substantial impacts on sustainability.

Although the specific context of planning documents varies considerably from city to city, there are general features that plans, particularly plans that present long-term sustainability objectives, have in common. Typically, city plans identify issues and needs, establish goals and objectives for addressing the issues, and set forth policies that provide direction for decision-making. Through plans cities can express their explicit commitment to sustainability by outlining how particular policy actions will address environmental, economic, and social issues in the community at large.

Plans are clearly important for shaping future development and resource allocation, but there is extensive variation in the geographic and policy scope the plan covers. For example, neighborhood plans tend to be geographically focused on specific areas within a city or are targeted to localized issues. In larger communities, sector, district, or master plans for residential, commercial, or mixed-use development may be focused on areas that are less that city wide in scope but are large enough to warrant a comprehensive and integrated approach to land use, transportation, housing, and other substantive planning and policy foci.

In comparison, a city sustainability plan, comprehensive, or master plan provides a long-range community-wide vision. They typically are organized around functional topics or planning subfields, such as energy, transportation and mobility, infrastructure, and environmental protection. They set forth goals and objectives for public decisions related to these subfields and identify mechanisms to implement policies related to a wide range of sustainability-related community issues. For instance, policies in a city-wide plan may seek to reduce auto-produced GHG emissions by enhancing pedestrian infrastructure, include objectives related to property reuse and reinvestment in urban neighborhoods through brownfield redevelopment in order reduce sprawl, and protect the environment by enhancing ecosystems through wetland restoration. Overarching city-wide plans likely take a more integrated approach to decision-making and can have positive impacts on the environment, economy, and equity that are associated with principles of sustainability.

Because city-wide plans impact a variety of stakeholders, the processes employed in their development are critical to their success in addressing community sustainability issues. Private businesses, land developers, homeowners, and a wide range of organized interest groups may be affected by planning policies. Scholarship suggests the methods employed by city staff to engage community stakeholders and solicit their input on community sustainability issues and solutions are essential for the integrity of the planning process (Hawkins and Wang 2012). Planning documents should represent the culmination of a process of community dialogue and reflect some degree of "consensus" on goals, objectives, and implementation action steps.

Municipal and strategic plans represent another planning mechanism that can impact city sustainability. Compared to a community-wide perspective, municipal operation plans are focused inward to city service delivery and the day-to-day activities of departments, units, and agencies within the city government. They emphasize the practices and operations of government units and are designed to influence how units minimize their impacts on the environment through, for example, direct delivery of services to residents and businesses, financial and human resources management, and procedures and processes for purchasing. Although they may not directly link to the substantive policy areas that are covered in city-wide plans, they are nonetheless critical to advancing sustainability principles. For instance, municipal operations plans may provide policies on how cities can reduce carbon footprints and reduce ecological and environmental impacts by constructing energy-efficient buildings or retrofitting existing municipal structures, incorporating best practices for storm water runoff into the management of municipal properties and infrastructure and implementing purchasing practices that reduce waste.

In the following section, we examine how the City of Orlando approaches planning and organizing for sustainability. The case study of the city's initiatives describes the use of two mechanisms described above—a city-wide sustainability plan and a municipal operations plan—and their development under the mayor's signature sustainability initiative called GreenWorks Orlando.

Case Study

The City of Orlando, Florida, is located in Central Florida and is the principal city of the Orlando-Kissimmee-Sanford Metropolitan Statistical Area. Over the last half century, Orlando's population and economy—and carbon footprint—have grown significantly. Between 2000 and 2015, the city

population grew from 194,723 to more than 277,173, representing a 42 percent increase that has been driven in large part by the tourism industry. Population estimates indicate that approximately 67,800 more people will be residing in Orlando by 2040—a 20 percent increase in population from 2015 levels. Similar to many large and growing cities across the county, Orlando's population growth reflects the increasing diversity of the American population. Nearly 18 percent of the city's residents are Hispanic, which has led city officials to reflect on how best to ensure equitable access to city amenities and employment opportunities for these residents—a core dimension of the sustainability concept. The city's economic profile has undoubtedly benefited from population expansion. During the last twenty years, the city has experienced significant employment increases in the technology, health care, and life science industries, and signature public-private development projects, including a performing arts center and soccer stadium, have led to housing and commercial investments throughout the city's downtown neighborhoods.

This economic growth has increased the city's financial resources, provided employment opportunities for residents, and generated positive economic spillovers and benefits to the region as a whole. However, the city faces significant environmental challenges. The Orlando Metropolitan Statistical Area (MSA) has among the most congested roads in America, leading to impaired air quality and urban runoff problems across Orlando. Buildings in Orlando account for more than 75 percent of greenhouse gas (GHG) emissions, and although the city's climate and geographic location provide great potential for solar energy production, less than 2 percent of Orlando's energy comes from renewable sources, and less than 1 percent is generated from solar. To fully offset Orlando's GHG emissions, it is estimated the city would have to plant 1000 trees per resident—approximately 250 million trees city wide. An expansion of the city's infrastructure footprint has also meant an increase in service delivery costs and concerns over the maintenance of public facilities. For example, the city maintains a fleet of approximately 2100 vehicles, with an average fuel economy of 17.6 miles per gallon of fuel. The costs of fueling this municipal fleet exceeds $5.3 million per year, and these vehicles are significant contributors to harmful emissions.

The city's initiatives to address these and other energy, climate, and urban sustainability issues had historically originated from different city departments and units. The lack of an overall policy framework limited the ability of local officials to focus the initiatives they had established by linking them to overarching city goals and aligning the fragmented and sometimes competing departmental initiatives with an agreed upon set of city sustainability

objectives. Moreover, the absence of a long-range energy- and sustainability-focused plan made it difficult to link specific policies and action steps to a specific sustainability issue and, perhaps more importantly, dedicate resources and establish a timeline and responsible department or unit for implementation. It also hampered the ability of staff and the general public to gauge the impact of city initiatives on meeting explicit sustainability objectives over time.

The City of Orlando established GreenWorks Orlando in 2007 as a mechanism to overcome these limitations and to implement the mayor's vision to "transform Orlando into one of the most environmentally-friendly, economically and social vibrant communities in the nation." The program was spearheaded by the mayor and was designed to promote sustainability based on five pillars: (1) conserve natural resource and protect the environment, (2) invest in green buildings, vehicles, and materials, (3) foster alternative transportation options, (4) increase the amount of green spaces and tree coverage in the city, and (5) work together as a community to combat the urgent threat of global climate change.

During the formative years of GreenWorks Orlando, the program was principally focused on capacity building and needs assessment. Capacity building was centered on assigning staff to manage the day-to-day activities of the program and developing an organizational structure from which activities would originate from. An important characteristic of GreenWorks Orlando is its location within the mayor's office. This gave it a high-profile relative to other city departments and units. Being located in the mayor's office enabled GreenWorks staff more direct access to department managers, including those in the budget and finance offices, the chief operating officer, and legal counsel. This organizational structure was symbolic—it signified an explicit commitment, by the mayor, to advance sustainability initiatives in the city. Studies suggest that when the headquarters of sustainability initiatives are in the mayor's or manager's office, it leads to more policies and greater integration across departments in policy implementation (Feiock et al. 2017).

In addition to establishing a clear organizational structure, the formative years included data collection. Staff were principally focused on developing a baseline of data from which to identify city sustainability issues and evaluate needs. GreenWorks Orlando staff collected data on issues ranging from energy use and efficiency, food systems, "green" employment, and other policy areas to understand the challenges and opportunities for making the mayor's vision a reality. The identification of issues was driven by the local context, such as the city's history, geographic location, demographic and economic changes, and issue saliency. GreenWorks Orlando staff also engaged professional

associations, such as the Urban Sustainability Directors Network, to learn best practices, trends in energy and climate change initiatives, and the successes and failures of policies in other cities.

As the initiative matured, two significant organizing mechanisms were established: the adoption of the GreenWorks Community Action Plan and the Municipal Operations Sustainability Plan. These planning projects provided both a long-range community-wide focus on sustainability through the community action plan and in recognition of the impacts city operations can have on the environment, an inward-focused municipal operations plan. Together they reflected the city's attempts to translate the city's vision identified by the mayor into workable policy solutions and action items. The following sections of this chapter highlight how Orlando explicitly expressed a commitment to environmental sustainability through these plans, the processes through which the plans were developed, and the impacts to date these planning initiatives have had on advancing the city's sustainability goals.

Community Action Plan

The establishment of GreenWorks Orlando enabled the city to pursue sustainability in a variety of ways. Among the more important implications of establishing the GreenWorks Orlando initiative was the organizing structure it provided in terms of staff, location within the city hierarchy, and financial resources that provided a foundation from which ideas on how the city can plan for and make explicit in policy documents a more sustainable city.

The first planning initiative conducted under the GreenWorks Orlando umbrella was the creation of the GreenWorks Orlando Community Action Plan. This city-wide plan outlined how Orlando intends to be one of the most environmentally friendly cities in the Southeast. There are three important considerations in the development of the plan. First, related to process, the mayor appointed a 20-member task force comprised of city staff and residents to identify community-wide sustainability issues and to make recommendations on policy and action items. The task force considered inputs from 14 roundtable meetings with subject-matter experts on 7 topics related to sustainability. This was complemented with public input from community meetings and an interactive online forum.

With over 270,000 in population, and a growing and diverse economy, the city committed to implementing a robust and comprehensive strategy of community engagement and generally followed the two distinctive strategies described by Portney (2005): a bottom-up and stakeholder-centric approach

that focused on assembling community support and a top-down approach of acquiring and applying technical expertise from professionals and experts.

The top-down approach is based on the idea that many sustainability issues are technical in nature and, thus, the acquisition of technical support from experts and professionals is the most effective way to solve the problem. During the years preceding the formal launch of the planning process, city staff were engaged in baseline data collection. The collection of this data provided a foundation to begin discussions with city stakeholders. The inclusive and deliberative citizen engagement process conducted by the city was initiated to influence stakeholders' appraisal of the issue and raise awareness of the need for policy and funding to address the issues identified by the city staff. This bottom-up approach, it is argued, improves the success rate of implementation because there is likely greater stakeholder "buy in" of community issues and goals, which is needed to obtain support from elected officials to adopt and implement the plan (Portney and Berry 2010). A combination of community engagement and expert-influenced processes is found to be particularly important in developing commitment to sustainability from elected officials—particularly the provision of financial resources to implement the initiatives (Wang et al. 2014; Wang et al. 2017).

This process resulted in the identification of goals and actionable strategies in seven distinct focus areas:

- Energy/green buildings
- Food systems
- Green economy
- Livability
- Solid waste
- Transportation
- Water

A second important consideration in developing the GreenWorks Community Action Plan was the direction given to the task force by the mayor's office. After staff and stakeholders identified sustainability issues by asking "why is the topic important to sustainability in Orlando and where is the City at today," the planning process emphasized two primary questions that would guide debate and dialogue among members of the task force as they honed the plan's goals and policies—(1) what are the environmental impacts? and (2) what is the potential for creating jobs that positively impact Orlando's economy? These questions reflect the city's attempt to reconcile two

priority areas that are often perceived to pull in opposite directions—economic growth and environmental protection.

In posing these questions, the city was asking participants of the planning process to explore the potential "co-benefits" that come from environmental-focused policy. The co-occurrence of local benefits—for example, the positive economic impacts from reduced traffic congestion, investments in green industries, and positive health benefits from reduced air and water pollution—is often advanced as an explanation for the pursuit of local sustainability efforts (Krause 2012). Highlighting the potential co-benefits, especially economic benefits that align with the goals of business elites and land developers, is particularly important when local officials must convince skeptics of the advantages of pursuing environmental objectives of sustainability (Bulkeley and Betsill 2003).

A third consideration in the development of the GreenWorks Community Action Plan is that it provided an umbrella mechanism from which other city plans would be related. The most significant of these plans was the comprehensive community plan. The city's comprehensive plan establishes goals and objectives for future land use, transportation systems, and parks and recreation, among other planning focus areas. The GreenWorks Orlando Community Action Plan and the Orlando Comprehensive Community Plan become self-reinforcing. For example, the future land use element includes goals and policy statements related to the use and management of land, zoning, and enforcement mechanisms that have long-term implications for city energy systems, including where solar panels can be constructed, design considerations, and the impact solar installation may have on abutting properties and municipal infrastructure. The GreenWorks Community Action Plan provided a policy reference for city staff who are developing new long-range growth management policies and updating municipal land use codes.

Municipal Operations Sustainability Plan

The second major planning effort to originate under the banner of GreenWorks Orlando was the Municipal Operations Sustainability Plan. This plan followed in the footsteps of the community action plan with the goal of the city becoming fully sustainable by the year 2030.

Through the development of this plan the city examined their ongoing operations, areas of improvement, and set forth aggressive goals that were intended to enhance economic opportunity for residents and businesses through environmental investments. The Municipal Operations Sustainability

Plan focuses on "transforming the City's governmental operations into one the most environmental sustainable governments in the United States."

The municipal operations plan is organized around nine substantive areas:

- Greenhouse gas emissions
- Green buildings
- Electricity
- Water
- Transportation/fleet
- Transportation/employee commuting
- Materials management and purchasing
- Urban forest
- Education

An important component of the municipal operations plan is the inclusion of benchmarks. Benchmarks include the baseline conditions and the future targets from which progress in achieving the short-term objectives is measured against. For example, in the municipal operations plan, a 15 percent reduction in GHG emissions (in tons of CO_2) from existing emissions is an objective used to evaluate progress in meeting the larger goal of becoming greenhouse gas neutral for municipal operations by 2030. The plan also includes action items that, when implemented, will lead to goal achievement.

A second important aspect of this planning approach is the annual progress reports produced by GreenWorks Orlando staff. The progress reports provide a reporting system whereby staff update elected officials on the actions item that have been implemented over the course of a year. The annual progress report also identifies the extent to which the goals have been achieved.

The establishment of this organizational structure enables the city embed commitments in planning documents. The first mechanisms are through its long-range comprehensive plan. The GreenWorks staff collaborated with the planning staff to identify sustainability issues and to create solutions.

Implications for Local Activities

What are the broader implications for advancing Orlando's sustainability efforts as a result of adopting the GreenWorks Orlando Community Action Plan and the Municipal Operations Sustainability Plan? Generally, the community action plan and municipal operations plan provided a coalescing

point of departure for the city's initiatives. They provided an explicit commitment to sustainability and focused the fragmented and sometimes competing departmental approaches to reducing harmful GHG emissions and promoting sustainable energy consumption.

The plans also established clear benchmarks the city established for itself but also the mechanisms and action steps the city would implement to achieve the goals. For example, among the city's sustainability goals expressed in the Community Action Plan are to ensure 100 percent of new and existing buildings meet green building standards by 2040, reduce GHG emissions by 90 percent from the 2010 levels by 2040, and reduce total electricity consumption by 20 percent from the 2010 levels by 2040.

Perhaps more important is the plan's outlined potential action steps and strategic partnerships that could be established to achieve these and other goals. One strategic initiative identified in the community action plan was to pursue a partnership with the City Energy Project. The City Energy Project is a national initiative to create healthier and more prosperous American cities by promoting energy-efficient buildings. The City of Orlando joined this project, and through this collaborative effort, the city is demonstrating its commitment to developing innovative, practical solutions that cut energy waste, boost local economies, and reduce harmful pollution—achieving the co-benefits of environmental protection. Collaborating with the City Energy Project has led to improved staff capacity in terms of technical expertise that enables the city to more effectively target proposed energy efficiency improvements of commercial buildings across the city. Engaging the City Energy Project, which is supported by the community action plan, provided a clear direction for staff via supporting owners and operators of buildings to reduce energy consumption and their carbon pollution, while expanding Orlando's energy services economy and encouraging the growth of clean energy jobs. Research suggests that a city's organizational design and resource commitments, through, for example, policy and planning documents, signal to prospective partners such as the City Energy Project that they will are willing and able to fulfil collaborative obligations (Hawkins et al. 2017).

Another initiative supported by the community action plan is the development of "Orlando Runs on Sun." This initiative is led by the City of Orlando, in collaboration with the Green Future Alliance, whose members have worked together to develop a strategic framework that identifies appropriate methods of integrating solar and other sustainable development practices into all major sectors of Central Florida. Participation in the City Energy Project and Orlando Runs on Sun is expected to promote two key aspects of the community action plan: promote environmental conservation and reducing harmful GHG pollutants and promoting green development and growth.

Lessons Learned

The case of Orlando's sustainability planning framework provides important lessons for local governments that are both actively engaged in promoting sustainability and that are developing a path toward success.

- The placement of GreenWorks Orlando in the mayor's office signaled its importance to the larger community and to city staff—environmental sustainability is a priority for the city.
- GreenWorks Orlando, as the city's overarching sustainability initiative, provided an explicit point person for policy implementation and from which collaborative activities originated from.
- The process of developing the Community Action Plan was inclusive and deliberative—a bottom-up approach to issue identification that was completed by a staff-driven technical perspective led to a plan that was accepted by a wide range of stakeholders.
- The Community Action Plan and the Municipal Operations Sustainability Plan included baseline data that was used to determine the extent to which the city is "moving the needle" and achieving its sustainability objectives.
- The planning documents outlined specific action steps for implementation, and the annual progress reports required staff to demonstrate whether the activities were completed and to document the outcomes.
- The Community Action Plan and the Municipal Operations Sustainability Plan articulated city goals and established policy direction and served as mechanisms through which the city has leveraged meaningful collaborative partnerships that have resulted in demonstrable progress in meeting the city's sustainability needs.

Challenges and Barriers

Although Orlando has made strides in achieving its goal of becoming the greenest city in America, there are a number of challenges it must overcome. One significant barrier is the propensity of surrounding communities to freely ride on the city's efforts. The city's investments in energy efficiency and using alternative energy sources to power its municipal buildings and fleet can have a positive impact on the goal of curbing GHG emissions. However, at a regional level, the city's actions may not have a significant impact if surrounding cities do not make similar investments. For some activities, a localized approach can certainly achieve environmental goals and produce economic

co-benefits, but a regionally integrated approach is necessary to meet sustainability goals that are very difficult to achieve if a city acts alone.

A second significant challenge for implementation is whether GreenWorks Orlando will continue under future city administrations. Although the initiative is promoted by the mayor, thus making it visible and a high priority, it has not been institutionalized via a city ordinance. Its future thus depends in part on whether future mayors see the value in the initiative and whether the Community Action Plan or the Municipal Operations Sustainability Plan aligns with his or her political incentives.

References

Bulkeley, Harriet, and Michele M. Betsill. 2003. *Cities and Climate Change: Urban Sustainability and Global Environmental Governance*. New York: Routledge.

Conroy, Maria M. 2006. Moving the Middle Ahead: Challenges and Opportunities of Sustainability in Indiana, Kentucky, and Ohio. *Journal of Planning Education and Research* 26: 18–72.

Feiock, Richard C., Rachel M. Krause, and Christopher V. Hawkins. 2017. The Impact of Administrative Structure on the Ability of City Governments to Overcome Functional Collective Action Dilemmas: A Climate and Energy Perspective. *Journal of Public Administration Research and Theory* 27 (4): 615–628.

Hawkins, Christopher V., and Xiaohu Wang. 2012. Sustainable Development Governance: Citizen Participation and Support Networks in Local Sustainability Initiatives. *Public Works and Management Policy* 17 (1): 7–29.

Hawkins, Christopher V., Rachel Krause, Richard Fejock, and Cali Curley. 2016. Making Meaningful Commitments: Accounting for Variation in Cities' Investments of Staff and Fiscal Resources to Sustainability. *Urban Studies* 53 (9): 1902–1924.

Hawkins, Christopher V., Rachel Krause, Cali Curly, and Richard Fejock. 2017. The Administration and Management of Environmental Sustainability Initiatives: A Collaborative Perspective. *Journal of Environmental Planning and Management*. https://doi.org/10.1080/09640568.2017.1379959.

Krause, Rachel M. 2012. Political Decision-Making and the Local Provision of Public Goods: The Case of Municipal Climate Protection in the US. *Urban Studies* 49 (11): 2399 417.

Krause, Rachel M., Richard C. Fejock, and Christopher V. Hawkins. 2016. Administrative Organization of Sustainability Within Local Government. *Journal of Public Administration Research and Theory* 26 (1): 113–127.

Portney, Kent E. 2005. Community Engagement and Sustainable Cities in the United States. *PublicAdministration Review* 65: 579–591.

———. 2013. *Taking Sustainable Cities Seriously: Economic Development, the Environment, and Quality of Life in American Cities*. MIT Press.

Portney, Kent E., and Jeffrey M. Berry. 2010. Participation and the Pursuit of Sustainability in U.S. Cities. *Urban Affairs Review* 46 (1): 119–139.

Wang, XiaoHu, Christopher V. Hawkins, Nick Lebredo, and Evan M. Berman. 2012. Capacity to Sustain Sustainability: A Study of U.S. Cities. *Public Administration Review* 72 (6): 841–853.

Wang, XiaoHu, Christopher V. Hawkins, and Evan Berman. 2014. Financing Sustainability and Stakeholder Engagement: Evidence from U.S. Cities. *Urban Affairs Review* 50 (6): 1–29.

Wang, Xiaohu, Liu Cheol, and Christopher V. Hawkins. 2017. Local Government Strategies for Financing Energy Efficiency Initiatives. *American Review of Pubic Administration* 47 (5): 672–686.

42

ZukunftGestalten@MUAS: Designing the Future at Munich University of Applied Science

Sascha Zinn and Ralf Isenmann

If your only tool is a hammer them every problem looks like a nail.
(Paul Watzlawick)

Background

As institutions for the education of future decision-makers and as centers for research and services, universities are playing a crucial role for the transformation toward a sustainable development. This responsibility is stated as a national objective in Germany's Basic Law (GG 20a[1]), just as it is in the higher education acts of the federal states of Germany and in the declaration of the "Hochschulrektorenkonferenz" (German University Rector Conference—HRK) "Hochschulen für nachhaltige Entwicklungen" (Universities for sustainable development—HRK 2016). With this declaration the HRK ties to the Copernicus Charta from 1994, which invoked the European universities to align to the guiding principle of sustainable development. Due to the Bologna-process and the correlated conversion to Bachelor and Master Programs, the Conference of the Responsible European Ministers for the Universities affirmed

S. Zinn (✉)
Center for Innovation in Teaching and Higher Education, University of Applied Science Munich, Munich, Germany

R. Isenmann
Business Administration in Innovation and Technology Management, Wilhelm Büchner Hochschule, Pfungstadt bei Darmstadt, Germany

R. Brinkmann, S. J. Garren (eds.), *The Palgrave Handbook of Sustainability*,
https://doi.org/10.1007/978-3-319-71389-2_42

the integration of higher education for sustainable development (HESD). "Our contribution for achieving the goal – education for all – should found on the principles of sustainable development and meet the current international activities in the guideline development for a quality standard of international university education" (KMEH 2005, 6 [own translation (ot)]).

However, these declarations of intent meet a sobering reality. In 2011, only 320 of the 14,000 degree courses have been identified as a course in the context of sustainability science (de Haan 2011, 3). One reason for this situation is certainly the challenging integration process of the interdisciplinary-funded sustainability science into the disciplinary structured universities. The missing fit between the interdisciplinary-oriented sustainability science and the disciplinary-oriented universities points out the various challenges which are associated with the integration of ESD in higher education. "The world has problems, universities have disciplines" (Müller-Christ 2011, 7 [ot]).

Munich University of Applied Sciences (MUAS) commits itself to this responsibility and thus challenges in a special way. Apart from "entrepreneurial" and "international", the university administration set "sustainable" as one of the general graduate qualifications. This means, that MUAS graduates are not just characterized by their disciplinary qualification profile, but also through their ability to shape a sustainable future development.

Case Study: Higher Education for Sustainable Development: A Competence-Orientated Didactical Approach: Cities and Sustainable Development or Why Focus on City Development

From a global point of view, cities have an enormous impact on demography and ecology—with rising tendency. Cities create jobs and offer shopping opportunities for the residents of the city-center and the suburban area. Cities are the powerhouse of the economic development. For example, the 750 biggest cities on earth are generating 57 percent of the global GDP. At the same time, cities offer residences for the largest part of the world population. Currently 54 percent of the global population lives in cities. In Germany, almost 75 percent of the population lives in cities. Because of this economic and demographic importance of the urban areas, a sustainable development can only be realized when the cities are the driver of a sustainable transformation.

The strong concentration of economic activities and population are causing social and ecological problem areas which react in a negative way with the aim

of a sustainable development. An example for a critical ecological issue within the cities is greenhouse gas emission: 70 percent of all generated gases are caused in cities. Additionally, a rising traffic volume inside cities harms the health of the local residents. Due to population growth, rents for apartments are escalating. Another critical element is the heterogeneous allocation of residents according to their origin, religion, income, and wealth. This leads to further social challenges. A present example is segmentation and gentrification, where poorer social classes are forced to move away from popular residential areas due to the rising rents. These are only a few of the economic, ecological, and social challenges which cities will confront in the near future.

The fundamental, social, cultural, ecological, and economic changes of our time are causing rising challenges for society, science, and politics. Dealing with these challenges in a successful way is only possible with an equal consideration of all ecological, social, and economic interdependencies. At the same time, these challenges are not located inside the area of a certain subject like engineering sciences, economics, or social sciences but between them. Therefore, inter- and transdisciplinary approaches are needed, which point out the different connections and convey a holistic approach.

Competence-Orientated Teaching

Descriptions on learning and acting under the conditions of a risk society (Beck 2012) always end up in a demand for competence-orientated teaching and learning. The content of this claim for competence orientation mostly stays unclear.

So, what are competencies? Volker Heyse and John Erpenbeck offer an elaborate answer: "Competencies characterize a person's ability to orient oneself within open, vast, complex and dynamic situations in a self-organized manner" (2009, XIII [ot]). Against this background, they declare competencies as "self-organizing dispositions" (2009, XIII). In another and still simpler way, we can define competencies as the ability to think and act in a *self-organized* way. In accordance to the classical understanding of competence, one could specify self-organized thinking and acting with regard to oneself (personal competence), based on subject-specific, methodological knowledge, experience, and expertise (professional and methodological competence) and with regard to one's ability toward cooperation and communication (social competence) (ibid., XIV).

In such an understanding, first of all competencies refer to a competent person and hence to an *autonomous* (self-organized) *subject*. What implicates this finding for competence-orientated teaching?

In summary, it can be said, that *competencies can be learned but they cannot be taught!*

Competencies cannot be learned like vocabularies, numerical sequences, or chemical equations could be. We can obtain this insight when we get aware of the fact that competencies are based on values and are fund on experience. "You can internalize values just for yourself, you can make experience just by yourself" (ibid., XX [ot]). The quality of an experience cannot be conveyed. Experiences can be described and therefore be communicated, but in order to gain a personal experience, individual thinking and feeling is necessary. This also applies for values. Values develop in the context of human emotionality. Values influence our actions not until they get an essential element of the personality. This happens through emotions and motivations. But emotions and motivations only get integrated into the personality when it comes to the confrontation with high-tension problem- and decision situations. Tense situations occur when students become embroiled in contradicting expectations (perturbation) through discrepancies and dissonances they cannot solve through mere cognitive performance (ibid., XX).

Didactic Consequences

> *Learning that is forming and maturing competencies, is a proper motion through which the learning subject develops the ability to solve problems properly and in a self-organized manner. By doing so, the subject moves in a learning environment (that sets a competence profile and ways of distribution), but at the same time realizes an inner world of learning (self-learning and constitution).* (Arnold and Erpenbeck 2014, 5f.)

The linked didactical demands are:

(1) From input to infrastructure;
(2) Reorientation from subject systemization toward situational dynamics
(3) From instruction to self-directed learning (Arnold and Erpenbeck 2014, 5f. [ot]).

From Input to Infrastructure

Current findings in learning research show that learning is not a passive incorporation of information but an active process of accessing the world (Siebert 2006). The formation and development of competencies are accomplished

through a proper motion of the learning subject, which develops problem solutions in a self-organized way. During this process, the learner moves within a learning environment but realizes an inner world of learning at the same time. Accordingly, the didactic perspective shifts from an institutionalized knowledge sharing toward a support of self-directed appropriation of competencies (Siebert 2006, 2). The change in perspective from a didactic of knowledge transfer to a didactic of self-directed appropriation of knowledge and competencies is essential. In that regard, teaching can "enable" the appropriation of knowledge. The change of perspective is closely connected to the concept of "didactics of enablement" (Arnold and Schüßler 2015 [ot]). The didactics of enablement basically aims the creation of stimulating learning environments and situations. In such an understanding, teachers are acting as coaches, providers, and occasionally as "resources of knowledge". Here the teacher is an integrated part of a dynamic teaching and learning system. In a didactical concept like this, teachers should enable, encourage, and support the self-directed learning process of their students.

Learning is most effective and efficient, when students' appropriate knowledge autonomously, experience its bearing capacity, and apply the insights in practice (Schüßler 2008). Therefore situation-oriented learning, which is learning in and through *characteristic key situations with their specific challenges*, proofs to be especially relevant. With this in mind, the call for competence-orientated teaching is a request to rethink university didactics. "At the core is on the one hand the systematic support of their student's self-directed learning competencies and on the other hand the creation of situation-oriented learning opportunities in order to attempt problem solving strategies ('Tools')" (Arnold and Erpenbeck 2014, 7 [ot]). It is about restructuring university didactics from *subject systemization* to *situational systemization*.

From Instruction to Self-Directed Learning

The logical consequence of the presented findings is the call for self-directed learning. According to the "classical" definition by Knowles (1975, 18) self-directed learning is: "a process in which individuals take the initiative, with or without the help of others, in diagnosing their learning needs, formulating their learning goals, identifying human and material resources for learning, choosing and implementing appropriate learning strategies, and evaluating learning outcomes". Special attention has to been given to the inherent process of assessment, which characterizes self-directed learning. This process

includes a constant loop of reflection and correction. Through this mechanism, the single elements of the learning process can be readjusted when needed. Even when the procedure of planning, execution, and control has to be accomplished autonomously, this does not mean the student has get along without any help. The teacher takes different roles during the learning process. He or she is an expert for the learning content, an active listener and productive questioner, an enabler of a concentrated and trusting learning atmosphere, a trainer who recommends exercises, and a facilitator in the sense of a "critical friend" (Siebert 2009, 104ff.).

Education for Sustainable Development: Which Competencies Do Students Need for a Successful (Working) Life and a Sustainable Society?

> *Sustainable Development and social cohesion depend critically on the competencies of all of our population – with competencies understood to cover knowledge, skills, attitudes and values*. (OECD 2005, 4)

The social, cultural, ecological, and economical changes of our time confront people with complex challenges. The guiding principle of "sustainable development" adds the approach of intra- and intergenerational justice. But which competencies are necessary in order to deal with these challenges?

On an international level, the Organization for Economic Co-Operation and Development (OECD) considered this question in their project *Definition and Selection of Competencies* (DeSeCo). Here the OECD differs between three categories of key competencies and assigned three specific competencies to each of them.

With the concept of *Gestaltungskompetenz* (the capacity to shape the future), the German discourse concerning "education for sustainable development" takes up the OECD's key competencies and extends them with the specific focus on sustainable development. "*Gestaltungskompetenz* means the specific capacity to act and solve problems. Those who possess this competence can help, through active participation, to modify and shape future society, and to guide its social, economic, technological and ecological changes along the lines for sustainable development" (de Haan 2010, 320).

De Haan (2010, 320) structures *Gestaltungskompetenz*into 12 subcompetencies, namely, the ability to:

(1) Gather knowledge in a spirit of openness to the world, integrating new perspectives;
(2) Think and act in a forward-looking manner;
(3) Acquire knowledge and acting in an interdisciplinary manner;
(4) Deal with incomplete and overly complex information;
(5) Cooperate in decision-making processes;
(6) Cope with individual dilemmatic situation of decision-making;
(7) Participate in collective decision-making processes;
(8) Motivate oneself as well as others to become active;
(9) Reflect upon one's own principles and those of others;
(10) Refer to the idea of equity in decision-making and planning actions;
(11) Plan and act autonomously; and
(12) Show empathy for and solidarity with the disadvantaged.

The OECD key competencies and the *Gestaltungskompetenz* with its 12 sub-competencies show correlation and development of competencies are shown in Table 42.1.

ZukunftGestalten@MUAS: A Trans-Disciplinary Teaching and Learning Laboratory for the Development of Competencies for Sustainability

As shown, the call for competence-oriented teaching implies to redesign higher education didactics and the development of new teaching and learning formats. The focus of the present conception is the creation of situation-oriented learning opportunities (*situation dynamics*) und the creation of a dynamic teaching and learning system (*infrastructure*) that enables *self-directed learning* and that aims the development of *Gestaltungskompetenz*. The overall context is illustrated by "The didactial map—ZukunftGestalten@MUAS" (Fig. 42.1).

The didactical concept presented here assumes an idea of man in which the learners are understood as active processors of reality. In this understanding, learning is an individual process of construction of a human mind. Accordingly, knowledge and competencies are not directly transferable. The didactic consequence lies in the orientation on the presented concept of a didactic of enablement and thus in the creation of stimulating learning environments and situations. Following up this creation of a stimulating learning environment is illustrated through the three dimensions: situation dynamics, infrastructure, and self-directed learning. Furthermore, the substantial relation to the development of *Gestaltungskompetenz* will be shown through the clarification of the specific arrangement of the learning situation.

Table 42.1 OECD key competencies and the Gestaltungskompetenz

Classical competence terms	Competence categories in line with OECD (2005)	Sub-competencies of Gestaltungskompetenz
Subject and methodological competence [M]	[M1] Interactive use of media and methods	T1 Gather knowledge in a spirit of openness to the world, integrating new perspectives
	[M1.1] Ability to use language symbols and text interactively	T2 Think and act in a forward-looking manner
	[M1.2] Ability to use knowledge and information interactively	T3 Acquire knowledge and act in an interdisciplinary manner
	[M1.3] Ability to use technologies interactively	T4 Deal with incomplete and overly complex information
Social competence [S]	[S1] Interacting in socially heterogeneous groups	G1 Co-operate in decision-making process
	[S1.1] Ability to maintain good and durable relationships with others	G2 Cope with individual dilemmatic situation of decision-making
	[S1.2] Ability to cooperate	G3 Participate in collective decision-making process
	[S.1.3] Ability to overcome and resolve problems	G4 motivate oneself as well as others to become active
Personal Competence [P]	[P1] Acting autonomously	E1 Reflect upon one´s own principles and those of others
	[P1.1] Ability to act within the wider context	E2 Refer to the idea of equity in decision-making and action planning
	[P1.2] Ability to form and implement a life plan and personal projects	E3 Plan and act autonomously
	[P1.3] Awareness of rights, interests, boundaries and requirements	E4 Show empathy for and solidarity with the disadvantaged

From Haan, G. de 2010, p. 321

Situational Systematology

The call for an opening toward situational dynamics is about creating situation-oriented learning opportunities. Therefore, the confrontation between students and "key situations with characteristic challenges" (Gary 2011) is essential. A key situation is a specific situation, which presents characteristic

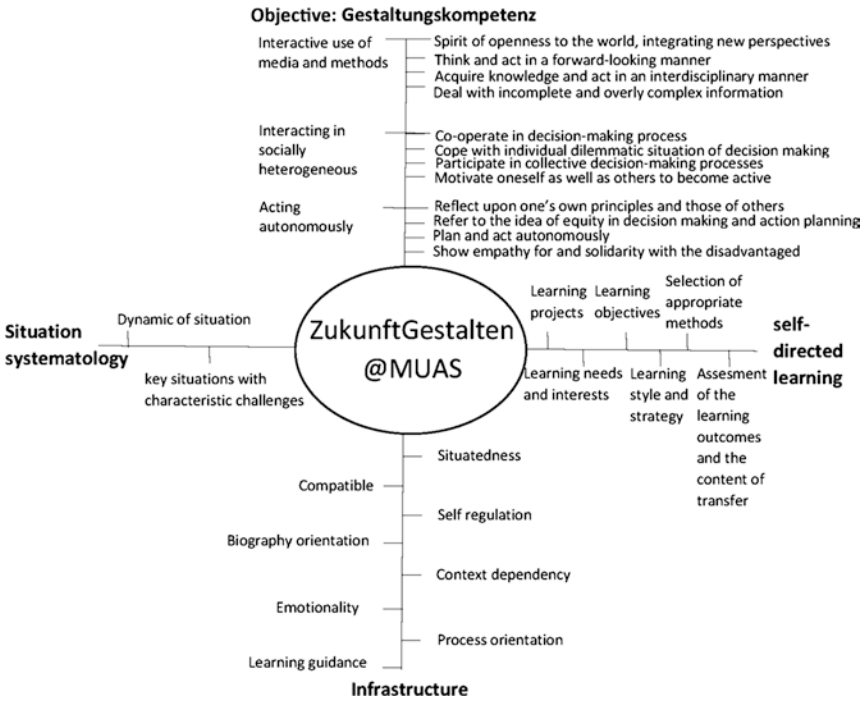


Fig. 42.1 The didactial map (Source: ZukunftGestalten@MUAS)

challenges that should be mastered and in which specific problem-solving strategies ("tools") can be attempted.

But what characterizes a key situation with characteristic challenges within the context of sustainable development?

Fundamentally the focus on development inherently implies the future perspective. In the confrontation with the topic of a sustainable development, we ask for the desired development and not about the prevention of disaster scenarios. ESD is about developing a vision for the future of society! The basic question is: how do we want our future to be like? What kind of future is possible? And how can we reach the desired future?

Key situations in the context of sustainable development are situations dealing with the future of society. The title of the course "ZukunftGestalten@MUAS" (DesigningFuture@MUAS) can be understood exactly that way. This approach is realized through the collaboration with partners concerning themselves with the constitution of society's future. For example, in the summer semester 2015, cooperation was launched with the Department of Urban Planning and Building Regulation of the city of Munich (Isenmann et al. 2016). In 2016, the collaboration was launched with the association for the development of the metropolitan region of Munich and its members.

Infrastructure

At the core, the underlying didactic concept aims to create stimulating learning environments and situations. That claim has been implemented through the collaboration with practice partners and the active support in dealing with real-life challenges (*Planning for Real*). Thus, the underlying approach goes way beyond a didactic postulate of situatedness, since knowledge and learning exercises not only refer to realistic problems and fields of application but knowledge and learning exercises are being acquired directly within real problems and fields of application. Because of the reference to the participant's very own lifeworld, their place of study and residence: the federal state capital Munich, the biographical reference (*biography orientation*), and the lifeworld contextualization (*context dependency*) are ensured (cf. Fig. 42.1). Furthermore, we pay attention to the attribute of process orientation (Siebert 2006, 89). This attribute is being realized on different levels: first of all, the activities of the students are embedded in a broader planning process. The working results are made accessible for the practice partners and the interested public through websites and can be used in further planning processes. On the other hand, the students work in small interdisciplinary groups, where reflecting one's own disciplinary perspective and integrating new perspectives is encouraged through the reflection in specific project diaries (T1 Gather knowledge in a spirit of openness to the world, integrating new perspectives). Furthermore, the integration of new perspectives is supported by the supervision of two coaches from distinct disciplines. Although the coaches are teachers, the term "coach" already points to the teacher's altered role awareness. In the case at hand, teachers primarily fulfill a supporting and advising function.

Self-Directed Learning

Self-directed learning is at the center of competence-orientated teaching. Respectively, it is core of the underlying didactic conception. Self-directed learning is implemented in respect to the abovementioned "levels of freedom" in learning. It starts out with the choice of topic. As previously pointed out, the students are confronted with key situations posing characteristic challenges. The task and the thematical frame are broad enough for the students to be able to work on a wide range of diverse learning projects within the task field. For example, was the task in 2015 to conceptualize "creative approaches and fresh views" (vision orientation) for a sustainable city development in Munich's north, for the space of action "Between Milbertshofen and

Freimann". The tasks in this area reached from dealing with the heavy population growth and the associated issues of densification and restructuring—so topics of social change—to economic and technical topics such as the expansion of BMW's center for research and innovation and the associated demand of technical infrastructure—so topics on economic structural change. This diversity of possible learning and working projects allows to process issues based on interest. Connected to the subject and content is the choice of suitable methods. Again, students can choose from the complete variety of methods that extend from the technically adept computer-based construction (CAD) to creative methods such as the mood board or the modeling.

Through their assessment of the learning- and working process, the coaches take a key role in this process. As "critical friends" and "productive questioners", the service of the coaches is of fundamental importance for the learning success.

The Development of *Gestaltungskompetenz*

The goal of ZukunftGesatlten@MUAS is the development of *Gestaltungskompetenz*. In the concept at hand, this goal is realized through the learning situation. Hereinafter, this realization will be pointed out in reference to "ZukunftGestalten@M—Future City", which was the seminar's title in the summer semester 2015.

As described above, the task given by the practice partner's is embedded in a broader planning context. Hereby it is referred to the key competence "acting in a broader context" (P1.1.) and the ability to think and act in a forward-looking manner (T2). With the reference to city planning and the underlying "space of action approach", students are confronted with an abundance of over-complex and incomplete information (T4) and can work out concepts and evaluation criteria autonomously and experience their load-bearing capacity trough experiments. Through the self-directed specification of the task and the associated planning procedure (E3), the students take part in cooperate decision-making processes (G1). Furthermore the focus of ZukunftGestalten is the competence to gain knowledge across disciplines (M3), where the reflection of the own subject-specific guiding principles (P1) is a fundamental part of. Besides the interdisciplinary constitution of the working groups, this focal point is also realized through the supervision of the coaches. Throughout the whole working process, the teams are supervised by coaches of different departments. Through this particular procedure we ensure that the interdisciplinary cooperation is provided from within, toward the

other team members, and from the outside, through the interdisciplinary team of coaches (team teaching).

In that regard, a whole plenitude of relations to other competencies could be identified. An example is the concept built upon the didactic principles of self-directed learning. Accordingly, the ability to act independently (P1) could be alluded to the project's learning subject just like a general competence of communication. All of them are essential for processing the project order and get developed throughout the course of the project.

Lessons Learned

In reference to the currently growing demand for interdisciplinary and competence-orientated teaching, ZukunftGestalten@MUAS can be described as a successful teaching innovation. The aim of ZukunftGestalten@MUAS was the conceptualization of an interdisciplinary teaching format dealing with the development of competencies concerning sustainability issues. Due to that demand, the course had to be, content-wise and format-wise, compatible with the specific demands of education for sustainable development as well as with the varying curricula and interests of students of distinct departments such as architecture, engineering, tourism management, and social work. To do so, the underlying concept could build upon the achievements and experience of the Real Projects[2] of the Strascheg Center for Entrepreneurship and the interdisciplinary teaching predecessor course "Wie viel Grün ist drin?" (How much green is in there?).

Challenges and Barriers

The development of such a teaching format comes along with an abundance of challenges and a significant organizational effort. For example, a proper time slot for the interdisciplinary cooperation has to be established throughout the departments. That presupposes not only the approval of the department administration but also of timetable managers and people responsible for the floor plan. Furthermore, such a teaching format has to be integrated into the curricula of every single degree course. Questions of the creditability of the academic performance have to be considered and answered in the light of a multitude of different study regulations.

In order to coordinate the project, personnel and financial resources are required. In the best case, a central coordination office already exists. In the

underlying case, it was a three-person project team consisting of a professorship for sustainable future management, a research assistant, and a coordinator. Simultaneously, such a format requires a high degree of flexibility and openness of the participating coaches. Interdisciplinary teaching formats are always positioned within an area of conflict between professional qualification on a vertical axis and personality development on a horizontal axis due to a societal demand for citizen education (Isenmann and Zollner 2014).

ZukunftGestalten@MUAS marks the attempt to create a frame for the development of competencies for sustainability. And yet, ZukunftGestalten@MUAS is more than a mere new teaching and learning format. It is part of a development process in higher education to competence-orientated teaching, which is a crucial factor for the future viability of universities and the success of the transformation toward a sustainable development itself.

The experiences and acknowledgments of all participants, participating students, teachers and practice partners, designate Zukunftgestalten@MUAS as "Good Practice" of interdisciplinary university teaching.

Acknowledgments This chapter is an outcome of the project: "Für die Zukunft gerüstet" (German, Future proof), funded by the Federal Ministry of Education and Research (BMBF), grant no. 01PL11025. This overall support is gratefully acknowledged.

Notes

1. (*Protection of the natural foundations of life and animals*) Mindful also of its responsibility toward future generations, the state shall protect the natural foundations of life and animals by legislation and, in accordance with law and justice, by executive and judicial action, all within the framework of the constitutional order.
2. http://www.sce.de/realprojects.html.

References

Arnold, R., and J. Erpenbeck. 2014. *Wissen ist keine Kompetenz. Dialoge zur Kompetenzreifung*. Hohengehren: Schneider Verlag.

Arnold, R., and I. Schüßler. 2015. Ermöglichungsdidaktik. Hohengehren: Schneider Verlag.

Beck, U. Risikogesellschaft. 2012. *Auf dem Weg in eine andere Moderne*. Frankfurt am Main: Suhrkamp.

Gary, T. 2011. *How to Do Your Case Study. A Guide for Students and Researchers*. London: Sage.

Haan, G. de. 2010. The Development of ESD-Related Competencies in Supportive Institutional Frameworks. *International Review of Education* 56 (2–3): 315–328.

———. 2011. Vorwort. In *Hochschulen für eine nachhaltige Entwicklung. Nachhaltigkeit in Forschung, Lehre und Betrieb*, ed. Deutsche UNESO-Kommission e.V. Bonn: VAS Verlag.

Heyse, V., and J. Erpenbeck. 2009. *Kompetenztraining. 64 Informations- und Trainingsprogramme*. 2nd ed. Stuttgart: Schäffer-Poeschel.

Hochschulrektorenkonferenz "Hochschulen für nachhaltige Entwicklung." Erklärung der Hochschulrektorenkonferenz (HRK) und der Deutschen UNESCO-Kommission (DUK) zur Hochschulbildung für nachhaltige Entwicklung. 2016. http://www.hrk.de/fileadmin/redaktion/A4/Hochschulen_und_Nachhaltigkeit_HRK_DUK.pdf.

Isenmann, R., and G. Zollner. 2014. Nachhaltigkeit in der x-disziplinären Lehre. Beispiele zum Einbezug von Nachhaltigkeitsthemen in die Betriebswirtschaftslehre mit Erfahrungen an der Hochschule München. In *Interdisziplinarität und Transdisziplinarität als Herausforderung akademischer Bildung. Innovative Konzepte für die Lehre an Hochschulen und Universitäten*, ed. C. Schier and E. Schwinger, 123–137. Bielefeld: Transcript.

Isenmann, R., S. Zinn, K. Kreulich, and A. Peter. 2016. ZukunftGestalten@HM – Future City. Transdisciplinary Approach Combining Higher Education for Sustainable Development and Designing the Future of the City of Munich in an Urban Real Lab Case. In *Engaging Stakeholders in Education for Sustainable Development at University Level*, ed. W.L. Filho and L. Brandli, 317–333. Cham: Springer.

Knowles, M. 1975. *Self-Directed Learning: A Guide for Learners and Teachers*. New York: Cambridge.

Konferenz der für die Hochschulen zuständigen europäischen Ministerinnen und Minister. 2016. Der europäische Hochschulraum – die Ziele verwirklichen. Bergen. 19–20 May 2005. http://www.hrk.de/fileadmin/redaktion/hrk/02-Dokumente/02-03-Studium/02-03-01-StudiumStudienreform/Bologna_Dokumente/Bergen_kommunique_2005.pdf.

Müller-Christ, G. 2011. Der Zug in Richtung Nachhaltigkeit fährt! Fahren Sie mit! In *Hochschulen für eine nachhaltige Entwicklung. Nachhaltigkeit in Forschung, Lehre und Betrieb*, ed. Deutsche UNESO Kommision e.V., 7. Bonn: VAS-Verlag.

OECD. 2005. The Definition and Selection of Key Competencies. Executive Summary: https://www.oecd.org/pisa/35070367.pdf.

Schüßler, I. 2008. Reflexives Lernen in der Erwachsenenbildung – zwischen Irritation und Kohärenz. *Bildungsforschung* 5 (2). http://bildungsforschung.org/index.php/bildungsforschung/article/view/75.

Siebert, H. 2006. *Didaktisches Handeln in der Erwachsenenbildung. Didaktik aus konstruktivistischer Sicht*. Augsburg: ZIEL – Zentrum für interdisziplinäres erfahrungsorientiertes Lernen.

———. 2009. *Selbstgesteuertes Lernen und Lernberatung. Konstruktivistische Perspektiven*. Augsburg: ZIEL – Zentrum für interdisziplinäres erfahrungsorientiertes Lernen.

43

Sustainable Transportation Planning in the BosWash Corridor

Michelle R. Oswald Beiler

Background

Sustainable transportation aims to reduce impacts on society, environment, and economy (triple bottom line) while promoting mobility (Litman 2016). This growing trend of shifting away from traditional vehicular mobility and toward more alternative forms such as walking, biking, and transit have reemerged as a high priority for transportation planners throughout the United States (US DOT 2017).

One unique region in the United States is the BosWash corridor, also referred to as Megalopolis. This corridor is one of the first emerging megaregions in the country identified by French geographer, Jean Gottmann (1961). The phrase "Megalopolis" refers to the interconnected string of cities spanning from Boston, Massachusetts, to Washington, D.C. "Megalopolis consists of 52,310 square miles stretching across 12 states, the District of Columbia and 124 counties" (Short 2009). One of the strong interconnections between these metropolitan areas is the transportation network initiated by rail and then eventually roadways (McNeil et al. 2010). However, within the last few decades, efforts to return back to mass transit as well as nonmotorized mobility, as means to provide intra-urban as well as inter-urban accessibility, have increased. Throughout this region, a number of sustainable transportation plans, facilities, and programs are being implemented.

M. R. Oswald Beiler (✉)
Civil and Environmental Engineering, Bucknell University, Lewisburg, PA, USA

R. Brinkmann, S. J. Garren (eds.), *The Palgrave Handbook of Sustainability*,
https://doi.org/10.1007/978-3-319-71389-2_43

This chapter explores sustainable transportation efforts, both non-motorized mobility and transit mobility, throughout the BosWash corridor. Strengths in promoting sustainable mobility as well as future challenges and barriers to shifting away from automobile reliance and toward a more balanced multimodal system are investigated.

BosWash Case Study

The BosWash corridor, also referred to as the Northeast Corridor, is ideal for exploring sustainable transportation planning efforts in the United States as there are a diverse set of constraints and opportunities within the region. Variations in density and land use allow for differences in mobility throughout the megaregion while transportation facilities provide interconnections between the cities. Some of the major cities connected within the BosWash include Boston, New York, Philadelphia, Baltimore, and Washington, D.C. (America 2050 2016), as shown in Fig. 43.1. Non-motorized systems, including trails, bike share programs, cycle lanes, and pedestrian programs, as

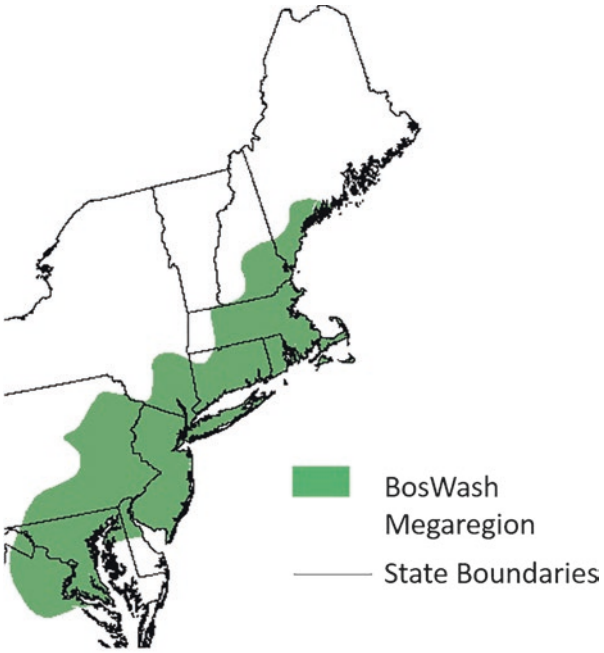


Fig. 43.1 BosWash megaregional corridor

well as transit systems including light rail systems, bus rapid transit (BRT) systems, and high-speed rail plans, are discussed in terms of their implementation in metropolitan areas within the corridor.

Non-Motorized Mobility

Non-motorized mobility such as walking and biking provide the opportunity for a number of environmental, social, and economic benefits such as reducing greenhouse gas emissions, improving public health and recreation, as well as promoting economic development (Rails-to-Trails Conservancy 2016a; Oswald Beiler and Waksmunski 2015; Litman 2014). As interest in pedestrian and cycling facilities increases, state DOTs continue to prioritize non-motorized mobility. Between 1999 and 2009, the Federal-aid Highway Program provided $5.2 billion for pedestrian and cycling projects with $1.125 billion spent in 2009 (AASHTO 2010). More recent legislation such as Moving Ahead for Progress in the 21st Century (MAP-21) and the Fixing America's Surface Transportation (FAST) Act has continued this support (FHWA 2016a, b). Facilities such as pedestrian plazas, cycle lanes, and trails as well as programs such as metropolitan bike shares and Safe Routes to School (SRTS) have been supported. The following section explores non-motorized facilities and programs using examples throughout the BosWash megaregion.

Pedestrian Facilities

Prior to streetcars, rail, and the automobile, city development and growth was based primarily on walkability. The "walking city" refers to pre-1880 where cities were based on accessibility by foot (Melosi 2010). This limited access led to growth within cities, compact development, and mixed land uses. The features of a walkable city, with the inclusion of transit mobility, form the guiding principles of traditional neighborhood development (TND). Today, TND, also referred to as "smart growth" or "new urbanism", refers to a return to a more walkable, transit-centric development (US EPA 2016; Sustainable Cities Institute 2013).

Many cities and towns throughout the BosWash corridor are implementing walkability plans. The walkability plans include both infrastructural improvements as well as incentives and programs for promoting pedestrian mobility. New York City, in particular, is well known as a "walking city" and the New

York City Department of Transportation supports a number of programs such as the NYC Plaza Program, WalkNYC, and Safe Routes for Seniors. The NYC Plaza Program (NYC DOT 2016a) provides funding for organizations to create neighborhood plazas (one day, interim, and permanent plazas) from underused streets throughout the city. The ultimate goal is to ensure that all New York residents live within a 10-minute walk of a pedestrian open-space area (NYC DOT 2016a). The WalkNYC program focuses on pedestrian wayfinding to provide a "clear visual language and graphic standards that can be universally understood" to further the walkability of the city (NYC DOT 2016b). Safe Routes for Seniors, a program that originally began in 2008, focuses on pedestrian safety issues for seniors in order to provide universal accessibility (NYC DOT 2016c). These programs as well as others allow the city to continue to provide safe, accessible, and pedestrian-oriented mobility to its residents.

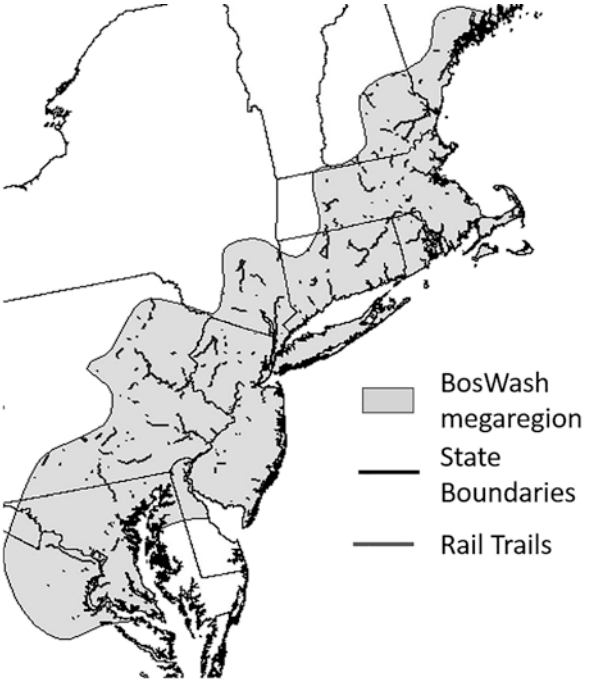
Another program that has become popular throughout the nation is SRTS. Similar to Safe Routes for Seniors, the SRTS program aims to provide pedestrian mobility for children accessing schools. The National Center for Safe Routes to School (2016a) provides training, tools, data, and funding opportunities for schools that aim to improve walkability and ultimately decrease childhood obesity rates. The SRTS program is based on the six "Es": evaluation, encouragement, education, enforcement, equity, and engineering (Safe Routes to School National Partnership 2016). Areas such as Rockville, MD; Ossining, NY; and Watertown, MA, have been identified as "success stories" as they have applied for funding and effectively utilized either infrastructural and/or programmatic changes (National Center for Safe Routes to School 2016b).

Bicycle Facilities and Programs

Within cities, urban bike facilities such as cycle lanes, shared lanes, and separated bikeways provide accessibility and connection to public uses. The BosWash megaregion cities, including Boston, New York, Philadelphia, Baltimore, and Washington, D.C., have their own bike right-of-way designations and programs. For example, Boston Bikes, sponsored by the Boston Transportation Department, aims to make Boston a "world-class bicycling city" (City of Boston 2016) by providing free bicycles to low-income residents, bike parking, and designated bike lanes. The department also supports Hubway which is the bike share program that serves Boston, Brookline, Cambridge, and Sommerville with over 185 stations and over 1750 shared bikes (Motivate International 2016). Similar programs exist throughout the other cities including DC Bikes in Washington, D.C., Baltimore Bike Share in Baltimore, IndeGo in Philadelphia, and Citi Bike in New York City.

Trails

Trail facilities, which are travel ways devoted toward walking, biking, in-line skating, and cross-country skiing (National Park Service 2016), provide the opportunity for recreational travel as well as commuting. Rail trails, hiking trails, as well as traditional shared-use pathways throughout the BosWash corridor provide connection within cities, between cities, as well as between states. The BosWash corridor was initially established based on a complex railway network that led to the growth and expansion of metropolitan areas (McNeil et al. 2010). After World War II, roadway development led to a surge of vehicular commuting and eventually shifted to become the dominant mode of choice. As rail lines continue to become abandoned, there is an opportunity to shift these facilities for non-motorized purposes, hence the growth of rail trails (Siderelis and Moore 1995). Currently, there are over 1900 rail trail facilities (abandoned rail lines converted to multi-use pathways which typically follow a flat or gentle grade) with over 700 projects in progress throughout the United States (Rails-to-Trails Conservancy 2016b). Figure 43.2 displays the rail trail



GIS source data: ESRI, 2016; America 2050, 2016; Rails-to-Trails Conservancy, 2015

Fig. 43.2 Rail trails in the BosWash megaregion

Fig. 43.3 NCR trail in Cockeysville, MD

facilities within the BosWash megaregion based on the Rails-to-Trails Conservancy (2015).

An example of a rail trail within the BosWash corridor is the Northern Central Railroad (NCR) Trail, also referred to as the Torrey C. Brown Rail Trail, which runs for 19.5 miles from Cockeysville, MD (Fig. 43.3), to New Freedom, PA. This trail continues on as the York County Heritage Trail which is another 21 miles long (Rails-to-Trails Conservancy 2016c). This crushed stone trail provides approximately 41 miles of interstate travel and passes through a number of smaller historic towns once served by the railroad.

Trails and other non-motorized facility modes serve as the foundation for sustainable neighborhood development. The next section discusses twenty-first-century transit systems which when combined with walkable networks can provide both intra-city and inter-city mobility.

Transit Mobility

The "spine" of the BosWash corridor was formed originally based on the railroad network that emerged connecting the metropolitan areas throughout the northeast (Stilgoe 1983). This interconnection between cities has been further

strengthened and expanded with the roadway development and production of the automobile (McNeil et al. 2010). With the goal of returning back to a more walkable and transit-friendly development, planners across the country are adopting methods such as transit-oriented design, utilizing both local and regional transit opportunities (Transit Oriented Development Institute 2016a). Example communities within Washington, D.C., include Bethesda Row, Rockville Town Center, City Center DC, and the Rosslyn-Ballston Corridor, each with a unique integration of the Metrorail, bus service, mixed-use facilities, and pedestrian improvements (Transit Oriented Development Institute 2016b).

Bus Rapid Transit

Transit-oriented development can include a mix of both local, regional, and national transit facilities. At the local level, bus rapid transit (BRT), which is a bus service that provides an on-street, separated right-of-way, designated for buses only in order to increase serviceability and decrease wait time (Institute for Transportation and Development Policy 2016). Philadelphia has adopted an enhanced bus service which reflects BRT characteristics in order to increase connectivity, specifically along Roosevelt Boulevard (Saksa 2015). In Boston, there is a study group advocating for BRT implementation along five corridors in Greater Boston including Dudley to Downtown, Harvard to Dudley, Readville to Forest Hills, Dudley to Mattapan, and Sullivan to Ruggles (The Greater Boston BRT Study Group 2015). In Washington, D.C., BRT has been implemented as of 2014. The initial BRT line, called Metroway, connects Crystal City to Braddock Road along Route 1 with the goal of providing premium bus service (Malouff 2014; WMATA and the City of Arlington 2016).

Light Rail Transit

At the local and regional levels, light rail service can provide both access on streets (similar to a streetcar) as well as between towns. Light Rail Transit (LRT) is a service that is based on tramcars riding on an exclusive right-of-way which increases serviceability as well as capacity. In Maryland, light rail service runs between Baltimore City stops (Camden Yards Ballpark and Penn Station) and towns outside of the city such as Glen Burnie, Timonium (Fig. 43.4), Hunt Valley, and so on. (MTA 2016). In addition, there is a line

Fig. 43.4 MTA Light Rail Station in Timonium, Maryland

that runs from Hunt Valley, MD, down to the BWI Marshall airport providing the opportunity for intermodal transfer (MTA 2016). New Jersey also has light rail including service between Hudson and Bergen, a Newark line, as well as the River Line (Trenton, Bordentown, Burlington, Riverside, and Camden) (NJ Transit 2016).

High-Speed Rail

As a result of the Rail Passenger Service Act, the BosWash corridor has been served by AMTRAK since the 1970s (AMTRAK 2016a). Providing inter-city passenger rail service over 456 miles, AMTRAK provides accessibility between the key metropolitan areas throughout the northeast (Washington, D.C., to Boston). At the turn of the century, AMTRAK (2010) began a service called ACELA which is an express service (approximately 6.5 hours between Washington, D.C., and Boston). More recently, AMTRAK has proposed a "Next-Generation (NextGen)" plan which includes high-speed rail options with the goal of reducing overall travel time between Washington, D.C., and Boston by over two hours (running at maximum operating speeds of 220 mph) (AMTRAK 2012). This proposed plan would substantially increase the

connectivity and further strengthen the spine of the Megalopolis corridor. As travel time decreases, the ability for increased social, economic, and political opportunities within an already strong megaregion continues.

At the more regional level, a study for a high-speed magnetic levitation (maglev) rail corridor between Baltimore and Washington, D.C., has been funded. The federal government awarded $27.8 million in 2015 to improve rail travel time along this 39.8-mile connection (Fritze 2015). Currently, AMTRAK's ACELA Express Service is about 35–40 minutes versus the 15-minute high-speed rail commute which is proposed (AMTRAK 2016b; Fritze 2015). The project, called the Baltimore-Washington Superconducting Maglev Project (SCMAGLEV), will be based on a transformative speed of 311 mph (The Northeast Maglev Project 2013). Efforts to plan, design, and eventually implement this system are ongoing in hopes of becoming the first maglev system in the United States.

Overall, transit is a key component of a sustainable city, in combination with walkability. Having increased accessibility and serviceability through mass transit encourages social and economic improvement within metropolitan areas. Walkable, transit-oriented communities serve as the foundation for the major cities in the BosWash corridor and will continue as support for smart growth increases.

Lessons Learned

Transforming communities throughout the Northeast Corridor requires planning, design, and construction that is context sensitive and unique to each locality. Context-sensitive design (or context-sensitive solutions) refers to an interactive and collaborative process that engages all stakeholders in the planning process (ITE 2016). This process can help to ensure that the proposed design provides a solution that addresses the social, historic, economic, and environmental needs of the community.

Sustainable designs such as transit-oriented development are only as effective as the number of people who use the system. Transit ridership typically correlates to residential density and housing development (compact vs. sprawl). Compact development with high density can encourage increased ridership rates and ultimately support the costs of implementation and operation. Therefore, designing a transit system that is context sensitive to the region and provides adequate ridership based on the type of mode (such as bus vs. light rail) is essential. The Victoria Transport Policy Institute (2016) provides recommended minimum density requirements (in dwelling units

per acre) for each transit mode, based on the original study by Pushkarev and Zupan (1977).

Also, the term "sustainable" can vary geographically in terms of what is beneficial to the environment, society, and economy. For example, a sustainable transportation system in New York may be very different than one in Alaska due to geography, climate, terrain, and so on. Therefore, understanding the regional influence is important especially when measuring the "sustainability" of a design.

Sustainable transportation rating systems, such as Greenroads (Greenroads Foundation 2016) and GreenPaths (Oswald Beiler and Waksmunski 2015), encourage regional sustainability through providing points for context-sensitive planning approaches and stakeholder participation. Local rating systems such as GreenLITES in New York (NYSDOT 2016) go even further as they are developed by individual agencies in order to measure sustainable transportation projects reflective of their region (geography, climate, etc.). The GreenLITES Project Design includes metrics under the categories of sustainable sites, water quality, materials and resources, energy and atmosphere, and innovation (NYSDOT 2016). A separate rating system was launched in 2009 to capture and address the sustainability measures related to operations and maintenance (GreenLITES Operations). These rating systems can be used to improve designs as well as compare the sustainability of design alternatives with the goal of reducing environmental, economic, and social impacts throughout the design, construction, and operation phases.

Challenges and Barriers

Implementation of walkable transit-oriented neighborhoods is not without challenges. After World War II, the demand for vehicular mobility initiated urban sprawl which led to suburbanization. As more residents wanted to live away from the city, faster and more direct routes were built (McNeil et al. 2010). The land use and planning cycle of building more roadways and increasing capacity in order to relieve congestion (University of Wisconsin 1999) creates a "build it and they will come" dilemma. This dilemma is explained by Anthony Downs' (2004) "triple convergence" where users make three changes as roadway capacity is increased: (1) temporal shift, (2) spatial shift, and (3) mode shift. Temporal shift is when users switch to peak times as a result of improved travel times. Spatial shift is switching from alternative routes to the improved roadway due to increased capacity. Lastly,

mode shift is when users forego other modes, such as transit or cycling, in lieu of adopting vehicular mobility due to the improved road capacity. These three shifts can lead to a cyclical dilemma which requires a change in infrastructure development. Supporting transit, cycling, and pedestrian infrastructure can allow for increased capacity while encouraging sustainable mobility. Promoting sustainable infrastructure combined with market incentives (such as transit subsidies) or disincentives (such as roadway tolls) can lead to decreased vehicular demand.

With regard to the BosWash corridor, Interstate 95 (I-95) is the vehicular "spine" of the corridor providing interconnectivity throughout the entire northeast (McNeil et al. 2010). This contributes to the vehicular demand, and, unfortunately, the Northeast Corridor includes 50 of the worst highway bottlenecks in the country (Northeast Corridor Infrastructure and Operations Advisory Commission 2014). As automobile travel still remains the most dominant mode for "journey to work" in the Northeast Corridor (74 percent), the growth of other modes such as cycling (increase of 69 percent between 2000 and 2011) is improving (US Census Bureau 2011). As sustainable infrastructure funding and plans for innovative mobility, such as high-speed rail, continue, there is the opportunity to improve the growth of these alternative modes.

Further Reading

The following references are provided as supplementary reading (in addition to the cited references in the next section) in regard to sustainable transportation planning and the BosWash Corridor. They are organized based on the following topics: background on sustainable transportation, non-motorized transportation, transit, and performance measures.

Background on Sustainable Transportation

Hamilton, Booz Allen. 2014. *Strategic Issues Facing Transportation, Volume 4: Sustainability as an Organizing Principle for Transportation Agencies, NCHRP Report 250*. Washington DC: Transportation Research Board.

Jeon, C., and A. Amekudzi. 2005. Addressing Sustainability in Transportation Systems: Definitions, Indicators, and Metrics. *Journal of Infrastructure Systems* 11 (1): 31–50.

Litman, T. (2016). *Issues in Sustainable Transportation,* Victoria Transport Policy Institute. Available from: http://www.vtpi.org/sus_iss.pdf.

NJDOT and PennDOT. (2008). *Smart Transportation Guidebook*. Available from: http://www.nj.gov/transportation/community/mobility/pdf/smarttransportationguidebook2008.pdf.

UC Davis. *National Center for Sustainable Transportation*. Institute of Transportation Studies. Available from: https://ncst.ucdavis.edu/.

Non-motorized Transportation

NACTO. 2013. *Urban Street Design Guide*. Washington DC: Island Press.

———. 2014. *Urban Bikeway Design Guide*. 2nd ed. Washington DC: Island Press.

National Center for Safe Routes to School. (2015). *Safe Routes to School Guide*. Available from: http://guide.saferoutesinfo.org/.

NYC DOT. (2015). *Street Design Manual.* Available from: http://www.nyc.gov/html/dot/html/pedestrians/streetdesignmanual.shtml.

Transit

AMTRAK. (2012). *The AMTRAK Vision for Northeast Corridor-2012 Update*. Available from: https://www.amtrak.com/ccurl/453/325/Amtrak-Vision-for-the-Northeast-Corridor.pdf.

Litman, T. (2015). *Evaluating Public Transit Benefits and Costs*. Victoria Transport Policy Institute. Available from: http://www.vtpi.org/tranben.pdf.

U.S. High Speed Rail Association. (2016). *Northeast Corridor High Speed Rail.* Available from: http://www.ushsr.com/hsr/nec.html.

WMATA. (2016). *Metro Sustainability Report 2016.* Available from: https://www.wmata.com/initiatives/programs/upload/Metro_Sustainability_Report_2016.pdf.

Performance Measures

FHWA. *INVEST-Sustainable Highways Initiative*. Available from: https://www.sustainablehighways.dot.gov/.

Greenroads Foundation. (2016). *Greenroads Rating System*. Available from: www.greenroads.org.

NYSDOT. (2016). *GreenLITES*. Available from: https://www.dot.ny.gov/programs/greenlites.

Oswald Beiler, M., and Waksmunski, E. (2015). Measuring the Sustainability of Shared-Use Paths: Development of the GreenPaths Rating System. *Journal of Transportation Engineering*, ASCE 141 (11), 04015026.

Oswald Beiler, M., S. McNeil, D. Ames, and R. Gayley. 2013. Identifying Resiliency Performance Measures for Megaregional Planning: A Case Study of the BosWash Transportation Corridor. *Transportation Research Record: Journal of the Transportation Research Board* 2397: 153–160.

References

AASHTO. 2010. *The Road to Livability: How State Department of Transportation Agencies are using Investments to Improve Livability*. http://www.infrastructureusa.org/wp-content/uploads/2010/04/aashto-road-to-livability.pdf.

America 2050. 2016. *Our Maps – GIS Shapefiles*. Regional Plan Association, http://www.america2050.org/maps/.

AMTRAK. 2010. *A Vision for High-Speed Rail in the Northeast Corridor*. https://www.amtrak.com/ccurl/214/393/A-Vision-for-High-Speed-Rail-in-the-Northeast-Corridor.pdf.

———. 2012. *The AMTRAK Vision for Northeast Corridor-2012 Update*. https://www.amtrak.com/ccurl/453/325/Amtrak-Vision-for-the-Northeast-Corridor.pdf.

———. 2016a. *The 1970's – The Journey Forward*. http://history.amtrak.com/amtraks-history/1970s.

———. 2016b. *Tickets – Northeast Regional.* https://tickets.amtrak.com/itd/amtrak.

City of Boston. 2016. Boston Bikes. https://www.boston.gov/departments/boston-bikes.

Downs, A. *Still Stuck in Traffic*. Washington DC: Brookings Institution Press. ESRI. (2016). *USA State Boundaries*. 2004. https://www.arcgis.com/home/item.html?id=540003aa59b047d7a1f465f7b1df1950.

FHWA. 2016a. *Moving Ahead for Progress in the 21st Century*. US DOT. https://www.fhwa.dot.gov/map21/.

———. 2016b. *Fixing America's Surface Transportation Act – Transportation Alternatives*. US DOT. https://www.fhwa.dot.gov/fastact/factsheets/transportationalternativesfs.cfm.

Fritze, J. 2015. Maryland Awarded $27.8 Million Grant for Maglev. *The Baltimore Sun*. http://www.baltimoresun.com/news/opinion/editorial/bs-md-maglev-grant-20151107-story.html.

Gottmann, Jean. 1961. *Megalopolis: The Urbanized Northeastern Seaboard of the US*. Cambridge: MIT Press.

Greenroads. 2016. *Greenroads Rating System*. https://www.greenroads.org/publications.

Institute for Transportation and Development Policy. 2016. *What Is BRT?* https://www.itdp.org/library/standards-and-guides/the-bus-rapid-transit-standard/what-is-brt/.

ITE. 2016. *Context Sensitive Solutions*. www.ite.org/css.

Litman, T. 2014. Economic Value of Walkability. *Victoria Transport Policy Institute.* http://www.vtpi.org/walkability.pdf.

Malouff, D. 2014. Alexandria's Metroway: BRT Open and Carrying Passengers, *Greater Greater Washington.* https://ggwash.org/view/35749/alexandrias-metroway-brt-open-and-carrying-passengers.

McNeil, S., Oswald, M., and Ames, D. 2010. *A Case Study of the BOSWASH Transportation Corridor: Observations based on Historical Analyses.* University of Delaware University Transportation Center: Newark. http://www.ce.udel.edu/UTC/Working_Paper_Observations_100907.pdf on December 8, 2016.

Melosi, M. 2010. *Automobile in American Life and Society – From Walking Cities to Automobile Cities*. http://www.autolife.umd.umich.edu/Environment/E_Casestudy/E_casestudy3.htm.

Motivate International. 2016. *About Hubway*. https://www.thehubway.com/about.

MTA. 2016. *Light Rail*. Maryland Department of Transportation. https://mta.maryland.gov/light-rail.

National Center for Safe Routes to School. 2016a. *History*. University of North Carolina Highway Safety Research Center. http://www.saferoutesinfo.org/about-us/history-srts.

———. 2016b. *Celebrating Local Successes*. University of North Carolina Highway Safety Research Center. http://www.saferoutesinfo.org/program-tools/success-stories/celebrating-local-successes.

National Park Service. 2016. *National Trails Systems – Frequently Asked Questions*. https://www.nps.gov/nts/nts_faq.html.

NJ Transit. 2016. *Light Rail Schedules*.http://www.njtransit.com/sf/sf_servlet.srv?hdnPageAction=LightRailTo.

Northeast Corridor Infrastructure and Operations Advisory Commission. 2014. *State of the Northeast Corridor Region Transportation System*. http://www.nec-commission.com/wp- content/uploads/2013/12/NECC_transportation_summary_report_2014-02-18.pdf.

NYC DOT. 2016a. NYC Plaza Program. The City of New York. Available from: http://www.nyc.gov/html/dot/html/pedestrians/nyc-plaza-program.shtml.

———. 2016b. *WalkNYC*. The City of New York. http://www.nyc.gov/html/dot/html/pedestrians/walknyc.shtml.

———. 2016c. *Safe Streets for Seniors*. The City of New York. http://www.nyc.gov/html/dot/html/pedestrians/safeseniors.shtml.

NYSDOT. 2016. *GreenLITES*. https://www.dot.ny.gov/programs/greenlites.

Oswald Beiler, M., and E. Waksmunski. 2015. Measuring the Sustainability of Shared-Use Paths: Development of the GreenPaths Rating System. *Journal of Transportation Engineering* 141 (11): 04015026.

Pushkarev, B., and Zupan, J. 1977. Public Transportation and Land Use Policy. *Indiana University Press (Bloomington)*. http://davidpritchard.org/sustrans/PusZup77/index.html.

Rails-to-Trails Conservancy. 2015. Rail Trails, Greenways, and Historic Canal Trails. GIS Data – From TrailLink.com.

———. 2016a. *Benefits of Rail Trails*. http://www.railstotrails.org/ourWork/trailBasics/benefits.html.

———. 2016b. *Trail Building Basics*. http://www.railstotrails.org/build-trails/trail-building-basics/.

———. 2016c. *TrailLink – Torrey C. Brown Rail Trail*. http://www.traillink.com/trail/torrey-c-brown-rail-trail.aspx.

Safe Routes to School National Partnership. 2016. *The 6 E's*. http://www.saferoutespartnership.org/healthy-communities/101/6Es.

Saksa, J. 2015. Plan for BRT-Lite Taking Shape along Roosevelt Boulevard Taking Shape. *Plan Philly*. http://planphilly.com/articles/2015/05/19/plans-for-brt-lite-along-roosevelt-boulevard-taking-shape.

Short, J.R. 2009. *Liquid City: Megalopolis and the Contemporary Northeast*. *Resources for the Future*, Washington DC.

Siderelis, C., and R. Moore. 1995. Outdoor Recreation Net Benefits of Rail-trails. *Journal of Leisure Research* 27 (4): 344–359.

Stilgoe, John R. 1983. *Metropolitan Corridor: Railroads and the American Scene*. New Haven: *Yale University Press*.

Sustainable Cities Institute. 2013. *Traditional Neighborhood Development*. National League of Cities. http://www.sustainablecitiesinstitute.org/topics/land-use-and-planning/traditional-neighborhood-development-(tnd).

The Greater Boston BRT Study Group. 2015. *Better Transit for Greater Boston*. http://www.bostonbrt.org/the-brt-report/.

The Northeast Maglev Project. 2013. *The Northeast Corridor*. http://northeastmaglev.com/northeast-corridor.

Transit Oriented Development Institute. 2016a. *Sustainability.* http://www.tod.org/sustainability.html.

———. 2016b. *Projects*. http://www.tod.org/projects.html.

University of Wisconsin. 1999. *An Overview: Land Use and Economic Development in Statewide Transportation Planning.* https://www4.uwm.edu/cuts/lu/lu-2.pdf.

US Census Bureau. American Community Survey. 2011. http://www.census.gov/acs/www/data/data-tables-and-tools/.

US DOT. 2017. *Our Sustainability Efforts.* https://www.transportation.gov/sustainability.

US EPA. 2016. *About Smart Growth*. https://www.epa.gov/smartgrowth/about-smart-growth.

Victoria Transport Policy Institute. 2016. *Transit Oriented Development*. http://www.vtpi.org/tdm/tdm45.htm.

WMATA and the City of Arlington. 2016. *Metroway Goes the Distance!* http://metrowayva.com/.

44

State-Sponsored Sustainability Within the Emirate of Abu Dhabi

Charles A. Matz III

Background

Rising from the hallucinatory heat refractions of Abu Dhabi's inland desert plateau is the compressed hulk of Madinat Masdar (Arabic: مدينة مصدر) or Masdar City. A building complex whose core function and extended program of use is dedicated to the exploration—at full scale and in real time—of alternative energy technologies, state-sanctioned investment models, and sustainable urban planning. It's August. Just past midday. Where the sun, at its zenith, forces the shadows of free-standing obstructions to linger motionless on the parched ground below. The fiercely hot shamal wind of mid-summer, with temperatures reaching upward of 47°C (117°F), carries fine particles of talc-like sweet infill, and sabkha-flats sand, across vast, open stretches of undeveloped land. Historically, during summer months, the people of the Trucial States, ancestors of Abu Dhabi's modern citizenry, migrated by camel and on foot, 65 km further inland, east, to the oasis encampment of Al-'Ain, for relief from the harsh climatic conditions and lack of fresh water. Now, dotted amongst the salty inlets of the Gulf's gossamer coastline, fixed concrete residential building blocks, as well as glass and steel towers, strain air-conditioning systems to capacity. Today, migration for most Abu Dhabians is limited to the

C. A. Matz III (✉)
School of Architecture and Design, New York Institute of Technology, New York, NY, USA

R. Brinkmann, S. J. Garren (eds.), *The Palgrave Handbook of Sustainability*,
https://doi.org/10.1007/978-3-319-71389-2_44

occasional overseas getaway. The contemporary and globally connected Emirate operates year-round, just as any other major metropolis, without regard to season or circumstance.

The silhouette of Masdar City is defined by the stunted complex of structures, 17 km east-south-east of the central island where the city of Abu Dhabi is located. Masdar's low-rise buildings, of various shapes and contrasting styles, sit on a unified platform over the remnants of the former municipal tree nursery site (a brownfield site). Following the global financial crisis of 2008, the group of buildings, largely dedicated to institutional research functions, survives in a mode of glacial, incremental growth. It's 2017, 11 years after its official launch, with small strides of progress visible yearly, to its vast conceptual footprint, countering the prevalent predictions of mission failure, and of dissolution of the planned vision. Activity occurs in discrete pockets. Presently, with residential housing constructed at the periphery of the core's administrative center. It's the ongoing tangible expression of effort to fully realize the seemingly outsized and explicit edict of HH Sheikh Mohammed bin Zayed bin Sultan Al-Nahyan (Arabic: محمد بن زايد بن سلطان آل نهيان), the Crown Prince of Abu Dhabi—a strategic plan actualizing energy technology diversification, from a singular hub, through innovation and research (Masdar.ae 2017). Its physical progress belies its substantial, structural, and organizational advance. Masdar is much more than a collection of buildings.

Masdar City's presence and continued role as catalyst for renewable energy research have galvanized both praise and criticism of its mandate with respect to its existence on United Arab Emirates (UAE) soil, its internal and external political dynamics, the actual or perceived excesses of the context within which it stands, and Abu Dhabi's societal model. These points of view—invariably external to the UAE—are projected against Masdar's founding sanction and its deliberately courted validation by some of the world's key, leading, Western, standard-bearing institutions of sustainability practice, such as the charity *World Wide Fund for Nature* (wwf.panda.org 2017), the group *BioRegional*, and the environmental NGO, *Greenpeace*.

Simultaneously, Abu Dhabi's structure as an autocracy, its reported controversial construction labor practices, and its inherent image, alongside its sister city—Dubai—of a city branded with high-value lifestyle activities, contradict key tenets of the Western validating organizations' own manifestos, which, in recent years, structurally link political democratic principles to sustainability standards. The project exists as a physical and organizational paradox, waiting by some in the West to be reconciled. In opposition to these views, are the arguments of national sovereignty, self-determination after centuries of

regional colonial interference, the reparative uplift of an historically bereft populace with few available natural resources (save oil and gas reserves discovered recently), and the rise of consciousness by the Gulf States of the need to press onward from finite petroleum production dependency.

The status quo is complex, multilayered, and inextricable from Abu Dhabi's geohistorical context, including its immutable role within the UAE—the federation of Emirates. A fully informed objective evaluation of the rise, current position, and possible outcome of the sustainability initiatives of the region, Abu Dhabi and, by extension and in a microcosm, Masdar City, creates a framework for more accurate global energy development policy deployment and calculated investment strategies. The project of Masdar is also the principal, iconic symbol of sustainability practice in Abu Dhabi, the region as a whole and by its scale globally, as a driver of alternative energy investment. In addition, the initiative and the effort it represents—irrespective of the success or failure of its stated goals—from its unique workings, inner organization, its metamorphosis, and well-promoted physical manifestation is, in fact, the expressed commander's intent of a nation. It is also a subject as precedent to which many actors within the sphere of renewable energy development may test their own eventual initiatives and outcomes.

Case Study: Abu Dhabi

Assessment Methodology

The material gathered is exploratory by nature, triangulating, via summary format, select qualitative and quantitative data compilation, within the disciplines of architecture, planning, and innovation strategy. It coalesces and relates, for interpretation by the reader, background, aspects of policy, benchmarks of stated activity, and reactions—against a regional backdrop—reporting on the current state of sustainability practice in Abu Dhabi. In addition, the qualitative relations are made on the subject of internal and external institutional stances of various actors, by recapitulating the geohistorical context, selectively comparing precedents, and summarizing the stated goals of the institutions cited and their policies for future development, against wider, global sustainability efforts. Sustainability practice in Abu Dhabi is inextricable from the Emirates as a whole and is best viewed through the region as a whole. Abu Dhabi facts and figures are presented in Table 44.1.

Table 44.1 The Emirate of Abu Dhabi: facts and figures

Basic Statistics	
The Emirate of Abu Dhabi—67,340 square km of landmass	
In 2015, the census reports 2.784 million people (1,831,741 males, 952,749 females)	
UAE nationals, 536,741, and non-nationals, 2,247,749	
The urban population counts 1,698,961 people in cities and the rural population is 1,085,529	
It is an Emirate holding nine percent of the world's oil and five percent of the gas reserves	
Economics	
The Gross Domestic Product (2014) was upward of AED 960,146 million (at current prices – 1 United Arab Emirates Dirham = 0.27 US Dollar (August 26, 2017)	The GDP per capita (2014) is AED 184.1 thousand (petroleum product), AED 177.3 thousand (non-petroleum product)
Contribution of the oil sector in GDP at current prices (2014) 50.9 percent	The value of oil, gas, and oil products exports was AED 185.2 billion
Contribution of the non-oil sector (2014) 49.1 percent	Value of non-oil exports was AED 30.8 billion
New Business (registered and renewed) (2016) 86,672	Value of re-exports was AED 18.8 billion
	Value of imports was AED 119.3 billion
	The inflation rate in 2016 was two percent
Agricultural Production (2015)	Agriculture and Natural Resources Indicators
Dates production: 93,075 tons, vegetable production (2013) 71,013 tons	Total agricultural area in Dunum (2015) 749,869
Dairy, poultry, and fisheries production (2014)	(1 Dunum = 1000 square meters, or ten acres)
Poultry production: 22,632 tons	Fruits: 272,322
Milk production (commercial farms): 102,783 tons	Field crops: 48,177
Quantity of fish caught: 5235 tons	Vegetables: 19,355
Livestock (2015)	
Sheep and goats: 3,084,477	
Cattle: 51,197	
Camels: 383,887	
Energy, Water, and Environment—Water and Electricity (2014)	
Electrical energy generated: 58,354,347 MWH	
Per capita electricity consumption: 19.89 MWH	
Desalinated water produced: 203,238 million imperial gallons	
Per capita desalinated water consumption: 256 gallons	
Average rainfall (2016): 74.1 millimeters	

Source: Abudhabi.ae (2017)

An Orchestrated Sustainability Policy Within the UAE: Abu Dhabi and Its Role Alongside Other Emirates

The UAE is a federation of seven Emirates, all absolute monarchies with the ruler of Abu Dhabi being the President of the UAE, and the ruler of the adjacent Emirate of Dubai acting as the Prime Minister (Government.ae 2017). Since 2004, Abu Dhabi is ruled by HH Sheikh Khalifa bin Zayed Al Nahyan (succeeding his father—the late Zayed bin Sultan bin Zayed Al Nahyan). He is assisted by the Executive Council of which he is the chair. The Council is composed of the General Secretariat of the Executive Council, the Executive Affairs Authority, and the Executive Committee and numerous subcommittees. There is a parallel legislative council (National Consultative Council) which maintains the traditional structure of consultation called the *Shura.* The various other councils are de facto ministries run by individual chairs and responsible for direct government control over institutional mandates in various public sectors. Abu Dhabi maintains its own local judicial system with court systems running independently of the UAE.

The UAE governing authorities, with the input of multiple, interrelated Emirate agencies, have prepared and published for policy implementation several seminal mandates, with explicit development frameworks, including components which have been impactful on the interrelationship of sustainable initiatives within and without Western standards of sustainability.

UAE Vision 2021 was launched in 2010 to define the agenda for overarching national, socioeconomic welfare standards. It is a key foundational document created toward benchmarking quality of life indices, in expectation of the 50th anniversary milestone of the Emirates' founding. Several sections of the document define agendas of sustainability that link policy formation of economic and social development, to competitive, knowledge-driven economy dynamics, infrastructure investment, and explicitly to sustainability practice.

Its stated goal outlines that:

> …the UAE Government wants to ensure sustainable development while preserving the environment, and to achieve a perfect balance between economic and social development. To do that, the UAE Vision 2021 National Agenda focuses on improving the quality of air, preserving water resources, increasing the contribution of clean energy and implementing green growth plans. Also, the National Agenda highlights the importance of infrastructure and aims for the UAE to be among the best in the world in the quality of airports, ports, road infrastructure, and electricity. And leading telecommunications infrastructure

> will allow the UAE to become a forerunner in the provision of Smart services. Finally, seeking to further improve the quality of life of its citizens, the Agenda has set a target to provide suitable housing for eligible UAE nationals within a record timeframe. (Vision2021.ae 2017)

Among the tenets of the UAE's national agenda are the 2016 indices, results, and standards based outline the current status and key sponsorship dynamics. That are presented in Tables 44.2 and 44.3.

We gather further insight by cross-referencing the same document's other effective sustainability-impacting standard and its current indicators for IP cultivation. Its stated competitive, knowledge economy goal outlines that:

> The global economy will witness significant economic changes in the coming years and the UAE Vision 2021 National Agenda aims for the UAE to be at its heart. As a result, it focuses on the UAE becoming the economic, touristic and commercial capital for more than two billion people by transitioning to a knowledge-based economy, promoting innovation and research and development, strengthening the regulatory framework for key sectors, and encouraging high value-adding sectors. … The National Agenda also aims for the UAE to be among the best in the world in entrepreneurship … Furthermore, the Agenda strives to instill an entrepreneurial culture in schools and universities … This will allow the UAE to be among the best in the world in ease of doing business, innovation, entrepreneurship and R&D indicators. … (Vision2021.ae 2017)

Sustainable Projects Within the Broader Context of the UAE: Dubai, Ajman, Fujairah, Sharjah, Ras al-Khaimah, and Umm al-Quwain

The UAE is a Constitutional Federation, with seven Emirates—Abu Dhabi, Dubai, Sharjah, Ajman, Umm al-Quwain, Ras al-Khaimah, and Fujairah. At Dubai's core is its historic role in fishing and pearling. In contemporary history, it exported its first oil product—which was discovered in 1966—in 1969. During the transition, its socioeconomic activities included the stabilization of an Islamic banking system (Dubai Islamic bank DIB, in 1970) and the Dubai Financial Market (DFM), the first global Shari'a-compliant exchange market. In addition to oil and tourism, Dubai currently promotes actively services and finance sector expansion. It paired the *UAE Vision 2021* plan with one of its own: *Dubai Plan 2012* and more recently with the *Dubai Clean Energy Strategy 2050.*

Table 44.2 National key performance indicators: sustainable environment and infrastructure

Index	Indicator	Definition	Source	Results	Key sponsor
1	Networked Readiness Index (Telecommunication and IT sectors)	A composite indicator that measures the readiness of a country to capture opportunities provided by information and communication technology to increase competitiveness based on (4) perspectives: Environment (the regulatory environment for information and communication technology and the environment for business and innovation), Readiness (infrastructure for information and communication technology and availability of expertise/skills), Usage (use of ICT by individuals, businesses, and government), and Impact (the economic and social impact of information and communication technology).	World Economic Forum—Global IT Report	Rank 26 (2016 Report)	Telecommunications Regulatory Authority
2	Share of Clean Energy Contribution	An indicator that measures the contribution of clean energy sources (renewable, nuclear) to the total energy mix	Ministry of Energy	0.31% (2015)	Ministry of Energy
3	Air Quality Index	An indicator that measures the quality of air in terms of supplying daily information on pollution and the negative effects it may have on human health. The indicator measures the (4) main air pollutants: nitrogen dioxide, carbon monoxide, sulfur dioxide, and ozone	Ministry of Climate Change and Environment in coordination with the National Center for Meteorology & Seismology	76.0% (2016)	Ministry of Climate Change and Environment

(*continued*)

Table 44.2 (continued)

Index	Indicator	Definition	Source	Results	Key sponsor
4	Percentage of Treated Waste of Total Waste Generated	An indicator that measures the percentage of treated waste out of the total generated waste (solid municipal waste) using various treatment methods (recycling, incineration, waste to energy, chemical treatment, exporting for external treatment, except for the landfill), in line with the methodology used by the OECD	Ministry of Climate Change and Environment in coordination with the Federal Competitiveness and Statistics Authority	22.60% (2016)	Ministry of Climate Change and Environment
5	Water Scarcity Index	An indicator that measures water overuse by monitoring fresh water usage (including surface water, renewable water and fossil water) as a percentage of overall renewable water in the UAE. The result is weighted to take into account desalination and wastewater treatment	Ministry of Energy	Ratio of 6.30 (2016)	Ministry of Energy
6	Quality of Air Transport Infrastructure	An indicator that measures the overall level of infrastructure at airports in the country and its adherence to international standards	World Economic Forum—Global Competitiveness Report	Rank 2 (2016–2017 Report)	General Civil Aviation Authority
7	Quality of Port Infrastructure	An indicator that measures the overall level of infrastructure of ports in the country and its adherence to international standards	World Economic Forum – Global Competitiveness Report	Rank 3 (2016–2017 Report)	Federal Transport Authority Land & Maritime

(*continued*)

Table 44.2 (continued)

Index	Indicator	Definition	Source	Results	Key sponsor
8	Logistics Performance Index	A composite indicator that measures the quality of infrastructure support for logistics activities based on a global survey on the performance of logistics in (6) perspectives: the effectiveness of border and customs management in terms of simplicity and speed, the quality of trade and transport infrastructure, the ease of shipping at competitive prices, the efficiency and quality of logistics services, the ability to track and trace cargo, and arrival of cargo to destinations on time	World Bank	Rank 13 (2016 Report)	Federal Transport Authority Land & Maritime
9	Quality of Overall Infrastructure (such as transportation, electricity and telephone lines)	A composite indicator that measures the overall level of infrastructure based on (2) perspectives: the infrastructure for transport and the infrastructure for electricity and telecommunication. The first perspective assesses the overall level and quality of road networks, air transport infrastructure and port infrastructure, while the second perspective assesses the quality of electricity supply and telecommunication infrastructure	World Economic Forum—Global Competitiveness Report	Rank 4 (2016–2017 Report)	Ministry of Infrastructure Development

(*continued*)

Table 44.2 (continued)

Index	Indicator	Definition	Source	Results	Key sponsor
10	Online Services Index	An indicator that measures the evolution of e-government services (smart services) in terms of availability, quality, connectivity and diversity of channels and the use by the public of these services	United Nations E-Government Survey	Rank 8 (2016 Report)	Telecommunications Regulatory Authority
11	Time to Obtain a Loan/ House from the Government for UAE Citizens	An indicator that measures the extent to which the country meets the housing needs of UAE citizens by measuring the waiting time between the date of application and the date of obtaining the loan/house (NKPI specific to UAE)	Sheikh Zayed Housing Programme	Work in progress	Sheikh Zayed Housing Programme

Source: Anon (2017)

Table 44.3 National key performance indicators: competitive knowledge economy

Index	Indicator	Definition	Source	Results	Key sponsor
1	Global Innovation Index	A composite index that measures the performance of innovation in countries. Innovation inputs are measured based on institutions, human capital and research, infrastructure, market sophistication, and business sophistication, while innovation output is measured by knowledge and technology outputs, and creative outputs	INSEAD	Rank 35 (2017 Report)	Ministry of Economy
2	Non-Oil Real GDP Growth	An indicator that measures the real annual economic growth of all sectors except oil. It is one of the most important macroeconomic indicators and reflects the overall state of the national economy over consecutive years. GDP includes the total value of annual production of goods and services	Federal Competitiveness and Statistics Authority	3.2% (Preliminary 2015)	Ministry of Economy
3	Gross National Income (GNI) per Capita	An indicator that measures the average income per person in a country. GNI includes the value of all the services and products that have been produced in the country (i.e. GDP) in a given year, in addition to the country's net income from abroad (such as dividends and interest)	World Bank	Rank 10 (2016 World Bank Estimate)	Ministry of Economy

(*continued*)

Table 44.3 (continued)

Index	Indicator	Definition	Source	Results	Key sponsor
4	Net Inflow of Foreign Direct Investment as Percentage of GDP	An indicator that measures foreign direct investment (FDI) as a percentage of GDP. FDI is defined as the amount of net inflow of investment required to achieve a lasting management interest (ten percent or more of voting stock) in an enterprise operating in an economy other than that of the investor. It is the sum of equity capital, reinvestment of earnings, other long-term and short-term capital, as shown in the balance of payments	United Nations Conference on Trade and Development (UNCTAD)	2.96% (2015)	Ministry of Economy
5	Global Competitiveness Index	A composite indicator that measures the competitiveness of countries based on (12) perspectives: institutions, infrastructure, macroeconomic environment, health and primary education, higher education and training, goods market efficiency, labor market efficiency, financial market development, technological readiness, market size, business sophistication, and innovation	World Economic Forum—Global Competitiveness Report	Rank 16 (2016–2017 Report)	Federal Competitiveness and Statistics Authority

(*continued*)

Table 44.3 (continued)

Index	Indicator	Definition	Source	Results	Key sponsor
6	Share of UAE Nationals in the Workforce	An indicator that measures the share of employed UAE nationals out of the total workforce (expatriates and nationals), across all sectors (NKPI specific to UAE)	Ministry of Human Resources and Emiratisation	3.93% (2016 Estimate)	Ministry of Human Resources and Emiratisation
7	Ease of Doing Business Index	A composite indicator that measures government procedures around business activity. It is based on (11) sub-indicators: starting a business, dealing with construction permits, getting electricity, registering property, getting credit, protecting minority investors, paying taxes, trading across borders, enforcing contracts, resolving insolvency, and labor market regulations	World Bank	Rank 26 (2017 Report)	Federal Competitiveness and Statistics Authority
8	Emiratisation Rate in the Private Sector	An indicator that measures the share of UAE nationals employed in the private sector, as a proportion of the total workers in the private sector (expatriates and nationals) (NKPI specific to UAE)	Ministry of Human Resources and Emiratisation	1.14% (2016 Estimate)	Ministry of Human Resources and Emiratisation
9	SME Contribution to Non-Oil GDP	An indicator that measures the share of GDP produced by small and medium-sized enterprises	Ministry of Economy and Federal Competitiveness and Statistics Authority	Work in Progress	Ministry of Economy

(*continued*)

Table 44.3 (continued)

Index	Indicator	Definition	Source	Results	Key sponsor
10	Global Entrepreneurship and Development Index (GEDI)	An indicator that measures three sub-indices: Entrepreneurial Attitudes (the general disposition of a country's population toward entrepreneurs, entrepreneurship, and business start-ups), Entrepreneurial Activity (the start-up activity in the medium- or high-technology sector initiated by educated entrepreneurs in response to business opportunities in a somewhat competitive environment), and Entrepreneurship Aspiration (the efforts of the early stage entrepreneur to introduce new products and services, develop new production processes, penetrate foreign markets, substantially increase the number of firm employees, and finance the business with either formal or informal venture capital, or both)	Global Entrepreneurship and Development Institute	Rank 19 (2017 Report)	Ministry of Economy

(*continued*)

Table 44.3 (continued)

Index	Indicator	Definition	Source	Results	Key sponsor
11	Share of "Knowledge Workers" in the Labor Force	An indicator that measures the share of highly skilled workers, workers in high-level professions, and workers classified under the International Standard Classification of Occupations (ISCO—08) of the total workforce. These jobs include legislators, managers, business executives, and specialists and technicians in the scientific, technical, and humanitarian fields (i.e. the top levels of the classification of occupations)	Ministry of Human Resources and Emiratisation	24.55% (2016)	Ministry of Human Resources and Emiratisation
12	Research and Development Expenditure as Percentage of GDP	An indicator that measures the total domestic expenditure on research and development (in the public, academic, and private sector), as a percentage of GDP	Federal Competitiveness and Statistics Authority	0.87% (2015)	Ministry of Education

Source: Anon (2017)

> In this context, the Dubai Clean Energy Strategy 2050 will change the rules of the energy game in the Middle East. The Dubai Supreme Council of Energy presented the ambitious Dubai Clean Energy Strategy 2050 in November 2015, with targets for clean energy in the mix increasing to 25% by 2030 and 75% by 2050. The implementation will be supported by funding of over AED 100 billion for investments as well as R&D and various projects. (Government of Dubai 2016)

Gaining traction from the extant strategic plan of 2015 and the sustainability goals of HH Sheikh Mohammed bin Rashid Al Maktoum, UAE Vice President and the Prime Minister and Ruler of Dubai, the 2050 plan called for an integrated set of strategic priorities to be focused on several areas of interest: economic development; social development; security, justice, and safety; infrastructure; land and the environment; government excellence. These roadmaps provide clear direction and accountability with metrics to all agencies of the national bureaucracy.

Other tangible initiatives, both involving private sector and governmental agencies—at various stages of development—include the work of Dubai Electricity and Water Authority (DEWA) (Emirates 24/7, 2013). Housed in a sustainably designed building in Al Quoz, it metes out various large-scale projects. DEWA, the energy authority founded in 1992, has launched the construction of the Gulf's largest hydroelectric project in Hatta, generating electricity from an existing dam and using solar energy to pump water back upstream during daylight hours. In order to keep in line with the goals of the Dubai Clean Energy Strategy 2050, it will contribute to the target of producing the generation of national energy up to seven percent by 2020, 25 percent by 2030, and by 2050 up to 75 percent of the national supply. In addition, DEWA signed a deal with Siemens, in 2015, to expand the capacity of the Jebel Ali M-Station, generating power up to 10,356 MW in conjunction with expanded desalination capacity (Khaleej Times 2015). A significant objective is the development of smart grid distribution:

> "Smart grids are a main component of smart cities, and we are building the world's first network that covers everything all the way to the customer, from generation to transmission to distribution. The smart grid will include demand side management, asset management, automation, transfer stations, automation of distribution networks, and the integration of systems and smart meters… DEWA is investing Dh7 billion in the smart grid initiative to support the Smart Dubai initiative, as well as its smart initiatives to produce solar electricity in buildings, connecting them to the grid, and building the infrastructure and

> charging stations for electric vehicles." Said Managing Director and CEO of DEWA, Saeed Mohammed Al-Tayer at the signing of the contract with Dietmar Siersdorfer, CEO of Siemens in the Middle East. (Khaleej Times 2015)

Other related projects include the Sustainable City, near Dubai city with recycled water, pedestrian zones, and localized 10 MW peak solar power generation, the Pacific Controls Headquarters Building, a more modest trial toward the region's first LEED (the Leadership in Energy and Environmental Design)-certified sustainable building. The commercial building includes systems which benefit from the use of solar thermal air-conditioning, photovoltaic cells, and a captive water treatment plant with integrated controls.

Although the other Emirates have more modest resources, they work in concert to fulfill their obligations of membership—either by creating foundational economic resources, educational initiatives, or industrial, sector-wide policy—all activity focuses on strategic support of the UAE. The Emirate of Ajman, led by the HH Sheikh Humaid bin Rashid Al Nuaimi, hosted the 2016 AIEC green energy conference to plumb the expertise of researchers, who in their presentations recommended a panoply of government initiatives and legislation for green development, sustainable energy in rural areas, solar energy, water recycling, and waste management. New architectural plans and buildings would be the test ground for new projects.

Fujairah is located on the eastern coast of the UAE along the Gulf of Oman. Its economy is based on agriculture irrigated by water runoff from the Hajjar mountain range. It occupies a key strategic position: direct access to the Indian Ocean. Its port is the world's largest for livestock shipping companies. Mining and stone processing services the construction activities of the other Emirates. Foreign investment banking and trade initiatives are a staple. Like other Emirates, it has put in place a strategic plan for growth. In 2015, *the Fujairah Plan 2040* was released. Terminals and airports are its major components.

Sharjah lies on both the Arabian and Omani coasts. Large desert regions dominate, alongside beaches, acacia forests, and marshland. Its role within the Emirates is defined through its educational institutions, where engineering and technology skills contribute to the UAE's sustainable initiatives.

At the northernmost tip of the UAE is the Emirate of Ras al-Khaimah. Alongside a modest agricultural sector, Ras al-Khaimah has launched business and industrial initiatives in the form of competitive free zones. Ras al-Khaimah Investment Authority (RAKIA) is the major proponent of economic development. Major cement manufacturing industries supply the wider UAE's building boom with raw construction materials. Julphar Gulf Pharmaceutical Industries LLC, located in Digdaga, supplies products to MENA regions.

The ruling family of Umm al-Quwain is from the Al-Mualla lineage of the Al-Ali tribe. The Emirate is ruled by HH Sheikh Saud bin Rashid Al-Mualla and is known for its poultry and fishing industries. The Ahmed Bin Rashid Port as well as its burgeoning free zones contribute to the economic foundation of the combined Emirati resources.

Abu Dhabi Sustainable Projects in Focus

The intersection between renewable energy goals and the socioeconomic indices of infrastructure modernization, education, technology stimuli, entrepreneurial support, and the formation of financial instruments of investment creates a foundational policy to which sustainability, in the UAE, can be defined. It outlines a combined framework unique to the Gulf, which meets some—but not all—of select Western organizations' sustainability practice standards. The Emirates use these specific platforms to track progress of sustainability metrics, in conjunction with, and in contrast to, the validation accords of many globally sanctioned models. Equivalencies can be made between the *UAE Vision 2021* goals regionally and the ones structured by the *World Wide Fund for Nature (WWF)/BioRegional—One Planet Living for Abu Dhabi's Masdar City* (see Table 44.4).

Masdar City—Madināt Masdar (Arabic: مدينة مصدر): A Galvanizing Urban Planning Project

Among the sustainability project initiatives in Abu Dhabi (the construction and planning projects of Mid field Terminal, Sheikha Fatima bint Mubarak Park, Sheikh Khalifa Medical City), none stand more emblematically for the state's mandate of sustainability and energy diversification than Masdar City. And certainly, none have attracted more critical scrutiny.

> And even if it were to become a perfect little urban melting pot, Masdar would have only limited relevance to the world most people live in. Mr. Foster's inspired synthesis of ancient and new technologies could well have applications elsewhere; it should be looked at closely by other architects…What Masdar really represents, in fact, is the crystallization of another global phenomenon: the growing division of the world into refined, high-end enclaves and vast formless ghettos where issues like sustainability have little immediate relevance. That's obviously not how Mr. Foster sees it. He said the city was intended to house a cross-section of society, from students to service workers. "It is not about social exclusion," he added. And yet Masdar seems like the fulfillment of

Table 44.4 The Masdar target one planet living standards

Zero Carbon	100 percent of energy supplied by renewable energy—photovoltaics, concentrated solar power, wind, waste to energy, and other technologies.
Zero Waste	99 percent diversion of waste from landfill (includes waste reduction measures, re-use of waste wherever possible, recycling, composting, waste to energy).
Sustainable Transport	Zero carbon emissions from transport within the city; implementation of measures to reduce the carbon cost of journeys to the city boundaries (through facilitating and encouraging the use of public transport, vehicle sharing, supporting low emissions vehicle initiatives).
Sustainable Materials	Specifying high recycled materials content within building products; tracking and encouraging the reduction of embodied energy within material sand throughout the construction process; specifying the use of sustainable materials such as Forest Stewardship Council-certified timber, bamboo, and other products.
Sustainable Food	Retail outlets to meet targets for supplying organic food and sustainable and or fair trade products.
Sustainable Water	Per capita water consumption to be at least 50 percent less than the national average; all wastewater to be re-used.
Habitats and Wildlife	All valuable species to be conserved or relocated with positive mitigation targets.
Culture and Heritage	Architecture to integrate local values.
Equity and Fair Trade	Fair wages and working conditions for all workers (including construction) as defined by international labor standards.
Health and Happiness	Facilities and events for every demographic group.

Source: WWF Global (2008)

that idea. Ever since the notion that thoughtful planning could improve the lot of humankind died out, sometime in the 1970s, both the megarich and the educated middle classes have increasingly found solace by walling themselves off inside a variety of mini-utopias. This has involved not only the proliferation of suburban gated communities, but also the transformation of city centers in places like Paris and New York into playgrounds for tourists and the rich. Masdar is the culmination of this trend: a self-sufficient society, lifted on a pedestal and outside the reach of most of the world's citizens. (Ouroussoff 2010)

…In 2008, Masdar City embarked on a daring journey to develop the world's most sustainable low-carbon city. From its inception, city planners knew that turning such a visionary concept into reality would be a major challenge. Today, Masdar City is successfully pioneering a "greenprint" for how cities can accommodate rapid urbanisation while dramatically reducing their energy and water needs and waste production. Masdar City is an ecosystem integrating knowledge, research and development, a technology cluster and a business and investment free zone. Our focus on innovation and sustainability is attractive to

> businesses, educational institutions and residents… Masdar City now offers a complete innovation ecosystem housing pioneering R&D and pilot facilities that nurture and implement ground-breaking solar energy, energy storage, green building and urban sustainability projects…The next phase of the city's evolution will see the development of Abu Dhabi's first R&D cluster hosting a range of pilot projects aimed at commercialising clean technologies, and served by a community including homes, schools, mosques, parks, restaurants, cafés and services outlets – all within walking distance of each other in a pleasant and sustainable urban environment. (MASDAR 2017)

The starkly differing realities expressed in the preceding excerpts represent contrasting expectations and dynamics of what Masdar City represents. They especially highlight divergent perspectives on the role of governmental organizations, business, societal structures, and governance models. They magnify for discussion the issues surrounding the very definition of sustainability in the context of non-Western governance models, inclusion or exclusion of democratic or socioeconomic principles as defined by sustainability regulatory bodies in the West. So, what Masdar City—the Masdar initiative—is, in the minds of the world's relevant bodies, can be viewed as relevant to the nature of the standard of sustainability being employed.

For Sir Norman Foster, the architect of Masdar City, Masdar was an opportunity—in 2007 as announced at the press launch of the project—to explore the sustainable urban planning model within the context of initiatives funded by patronage. Launched at Cityscape Abu Dhabi, the announcement boasted the backing of the Abu Dhabi Future Energy Company. It was to provide a blueprint for development.

> …It is an ambitious project that will attract the highest levels of international expertise and commerce, providing a mixed-use, high-density city. The exciting programme includes a new university, the Headquarters for Abu Dhabi's Future Energy Company, special economic zones and an Innovation Center…The environmental ambitions of the Masdar Initiative – zero carbon and waste free – are a world first. They have provided us with a challenging design brief that promises to question conventional urban wisdom at a fundamental level. Masdar promises to set new benchmarks for the sustainable city of the future. (Fosters+Partners 2007)

The Economist reported that the rulers of Abu Dhabi, led by Sultan Ahmed Al-Jaber—the Minister of State, UAE, and the Group CEO of the Abu Dhabi National Oil Company as well as the Chairman of Masdar—sees the project as a way to create development rather than strictly formulating environmental

initiatives. Diversification and intellectual capital growth, alongside the trial of economic mechanisms toward renewable energy, is to be the result of the project—with Masdar City as the lightning rod for expertise and coalition partnerships (The Economist 2008). The selection of partners is key to weighing the activities and elements which Masdar heralds. MIT (Massachusetts Institute of Technology) and Siemens (the largest technology conglomerate headquartered in Berlin and Munich) play crucial roles. MIT and the Masdar Institute Cooperative Program launched the Masdar Institute in 2007 and still cooperate on projects, both modest and far-reaching, building capacity for research and development. As of 2016 nine Masdar Institute-MIT research projects were on the boards including the creation and implementation of a 3D urban microclimate model of Abu Dhabi, downtown. The city's municipality will be able to tackle heat island effects of future construction. The MIT partnership defines the advance and applied research characteristics of the mandate. (MIT News Office 2016)

Siemens-Masdar is another long-standing partnership (Siemens-Masdar 2010). Masdar City hosts Siemens' regional headquarters. The physical presence of the German technology giant, again, reinforces the mandate of energy development. In 2017 projects included the Smart Grid and Smart Building Center of Excellence. Masdar Institute's Annual strategic plan states that the joint center is to be the cornerstone of Masdar Institute's broader Smart Infrastructure initiative. Collaboration with Siemens has focused on solar energy, the use of smart grids, buildings, carbon capture, and storage. The mechanisms for development partnering include academic activities, funding opportunities, and research horsepower. Siemens represents the technological execution characteristics of the mandate.

Masdar also promotes outward facing events and conferences, which have included, since 2008, the annual Abu Dhabi Sustainability Week (ADSW) promoting and highlighting socioeconomic and environmental trends. Future conferences include the 2018 World Future Energy Summit Conference, which has been billed as the conference platform for renewable energy and clean technology. The emphasis of the conference is on private and public sectors cooperation.

In 2015 the international organization, IRENA (International Renewable Energy Agency), established its headquarters in Masdar City. It is an intergovernmental organization with multiple member countries for international-scale cooperation, with a center of excellence, policy creation, technology, and financial information sharing on renewable energy. IRENA's mandate includes the adoption and development efforts of renewable energy, bio, geothermal, hydro, ocean, solar, and wind energy in the pursuit of sustainable

development, energy access, energy security, and low-carbon economic growth and prosperity (Irena.org 2017).

The global economic crisis of 2008 impacted Masdar City's progress. Abu Dhabi was called upon, by its sister city Dubai, to bail out an unserviceable debt of USD 59 billion. Construction on Masdar City ground to a halt. Unfinished structures remained vacant.

> The crisis led to the Emirati housing market crashing. The city's rental-income projections collapsed overnight and, with them, any hope of finishing the site by 2015. Out went the dream of 50,000 residents and a zero-carbon settlement…the plug was more or less quietly pulled on six million square metres at Masdar City. (Kingsley 2013)

The future of Masdar City is in flux. Ambiguous outcomes and volatile technological landscapes are the hallmark of current innovation projects and Masdar is subject to the mores of the industry. In 2016 Masdar City attracted criticism for its failure to realize its original intent of a zero-carbon city. Susan Goldberg, of *The Guardian*, wrote:

> Years from now passing travellers may marvel at the grandeur and the folly of the futuristic landscape on the edges of Abu Dhabi: the barely occupied office blocks, the deserted streets, the vast tracts of undeveloped land and – most of all – the abandoned dream of a zero-carbon city. Masdar City, when it was first conceived a decade ago, was intended to revolutionise thinking about cities and the built environment. Now the world's first planned sustainable city – the marquee project of the United Arab Emirates' (UAE) plan to diversify the economy from fossil fuels – could well be the world's first green ghost town. As of this year – when Masdar was originally scheduled for completion – managers have given up on the original goal of building the world's first planned zero-carbon city. Masdar City is nowhere close to zeroing out its greenhouse gas emissions now, even at a fraction of its planned footprint. And it will not reach that goal even if the development ever gets fully built, the authorities admitted. 'We are not going to try to shoehorn renewable energy into the city just to justify a definition created within a boundary,' said Chris Wan, the design manager for Masdar City. 'As of today, it's not a net zero future,' he said. 'It's about 50%.' When Masdar City began, in 2006, the project was touted as a model for a green mixed-use urban landscape: a global hub for the cleantech industry, with 50,000 residents and 40,000 commuters…Mubadala, Abu Dhabi's state-owned investment company, pledged financial support to

> the estimated $22bn experiment in urban design. Ten years on, however, only a fraction of the town has been built – less than 5% of the original six square km "greenprint", as Wan called it. The completion date has been pushed back to 2030. (Goldberg 2016)

Criticism has extended to the project, through to the UAE and to Abu Dhabi via the development and use of their own sustainability standards. The UAE has taken steps toward a self-validation governance model, excluding the overarching Western-style rating systems. Key sustainability indices are formed under the initiatives of the nascent Environmental Law in Abu Dhabi—ESTIDAMA—or the Pearl Rating System and initiatives of regulation by the Abu Dhabi Urban Planning Council (UPC).

Mubadala

One vital lens through which Masdar City and sustainable practice activity in Abu Dhabi is to be viewed includes the organizational structure of the various institutions which have come to shape it, Mubadala being the most influential. It is worth noting that the engine of sustainability in Abu Dhabi is the state-sanctioned entity Mubadala, which is largely structured as an investment entity. Structurally, the organizations are linked from the top via the government's Mubadala Development Company, through Mubadala Energy Division (2015), then through to Masdar, and finally with Masdar—comprising four business units: Masdar Capital, Masdar Clean Energy, Masdar Special Projects, and finally Masdar City. At the margin of this structure lies the Masdar Institute—an independent graduate university specializing in research (Mubadala.com 2017).

Mubadala's published mandate states that "…Mubadala is a pioneering global investor, deploying capital with integrity and ingenuity to accelerate economic growth for the long-term benefit of Abu Dhabi."

Mubadala is entrenched in a reported 13 business sectors, aggregated, and inclusive of petroleum and petrochemical industries across the value chain—from upstream location and extraction businesses—to refining and midstream transport, and delivery. Diversification of its other holdings include manufacturing and mining, with value chain influence in aluminum, zinc, copper, and gold. Related business sectors include the semiconductors industry, GLOBALFOUNDRIES and Advanced Micro Devices. Five other sub-sectors

include aerospace, renewables, ICT (AR&I), utilities, and defense. It includes operations of large-scale integrated capital investments, healthcare, real estate, and infrastructure.

Masdar City is the physical manifestation of the larger policy structure of Abu Dhabi in deploying its vision and mandate. Masdar City encapsulates, in an iconic, recognizable moniker, the internal dynamics of a larger regional, and global development strategy.

Masdar's published mandate states: "Established in 2006, Masdar is a commercially driven, international renewable energy and sustainability company that advances solutions in energy, water, urban development and clean technologies."

Furthermore, Masdar's company vision statement states: "To make Abu Dhabi the preeminent source of renewable energy knowledge, development and implementation, and the world's benchmark for sustainable development." And its mission statement: "To advance renewable energy and sustainable technologies through education, research and development, investment, commercialisation and adoption" (Masdar.ae 2017).

Broader Regional Sustainability: The Gulf in Relation to MENA/MENAP

A driver of investment in sustainable projects, where a reasonable likelihood of a positive return on investment or outcome is expected, is regional stability. The IMF and the World Bank report that the ongoing conflicts, oil export and import price dynamics (with low prices and counteractive measures of production restriction by GCC countries in 2016–2017) experienced, and the rates of diversification of economies of the Middle East and North African regions, pose continued risk for financial development. The IMF, in its spring 2017 report, comments on the specific issues of structural reform in relation to energy sectors, of countries of the MENAP region (International Monetary Fund, Middle East and Central Asia Department 2017):

> Persistently lower hydrocarbon revenues mean that the current development model based on a redistribution of oil wealth through government jobs and generous subsidies is no longer sustainable. The challenge, therefore, is to develop a new model of economic growth that is both resilient and inclusive. In

> particular, there is a need to reduce the dependence on oil and generate private sector jobs for the rapidly growing labor force. (International Monetary Fund, Middle East and Central Asia Department 2017)

It posits that economic growth hinges on diversification of the economies of oil-producing countries, as an essential direction to future sustainability. The MENA region includes oil-importing countries with less subsidy. In 2013 Jones Lang LaSalle reported that progress toward binding regulation, which are crucial in any sustainability effort, in the MENA region—external of the UAE—has been minimal. Everington, from the National (2013) reports on the factors: "The limited progress to-date is due mainly to a lack of legislation, the absence of any discernible financial premium, the heavily subsidised energy, water and waste disposal costs in the region as well as the limited awareness of environmental issues."

These countries are impacted most by their status as developing nations with unstable and ill-formed infrastructure development. Wealth is a key factor in political will or choice of development investment.

Other initiatives in MENA regions include: King Abdullah University of Science and Technology (Saudi Arabia), King Abdullah Financial District (Riyadh, Saudi Arabia), Barwa Financial District (Qatar), Msheireb (Downtown Doha, Qatar), Qatar National Convention Centre (Doha), Bahrain World Trade Center (Manama, Bahrain).

Lessons Learned

The sociopolitical and geohistorical dynamics of the present-day Gulf region have been shaped and molded, over the last several hundred years, by the dynamics and subsequent fates of the European, Ottoman, and Persian powers. And to this day, the legacy of the unique structures—which were put in place to control the trade routes between the Indian Ocean and the West—still exerts an influence and color the policies and agreements between the UAE and their extraneous partners.

Internal loyalties, goals, and priorities of development between Emirate members are prioritized to stabilize regional power and to clarify cultural identity and autonomy. Activity in Abu Dhabi flows in support of these overarching prerogatives, including the initiation, furthering, and very definition

of sustainability. It should be noted that the brevity of the current contemporary era (1961 to today), and the extreme pivot between traditional Gulf culture, prevalent in the Trucial period, and what exists now, has not yielded conclusive results toward the assessment of success or failure of sustainability within the context of the UAE—and to the very definition of what sustainability means within the context of the Gulf, or what standards of sustainability should be used. To this date only a handful of initiatives of this type and of this scale have been launched in either the private or public sector globally; and the microcosm Abu Dhabi affords can yield important information regarding systems of dynamics of practice and policy for all countries interested in these matters.

Challenges and Barriers

Fundamental questions regarding sustainability practice, vis-a-vis the Emirate of Abu Dhabi, are:

- To what extent are the measures of Western sustainability practices relevant to sustainability of a region with no natural resources other than oil and gas and with extant extreme environmental factors?
- What impact has the 400-year-long residency of extra-regional forces had on the baseline of commencement of sustainable practices?
- Should sustainable practices, relating governmental systems, political policy, human rights, and definitions of democratic systems be used in the validation of regional efforts, especially in countries with non-Western forms of rule?
- What is the measured effectiveness of state-sponsored energy policies, including key global investment strategies, in the broader sustainability context and what actors and institutions should regulate global intellectual property and investment in the sustainability sphere, alternative energy, and innovation?

Bibliography

Al Fahim, M.
From Rags to Riches
Al Fahim, M. 2013. *From Rags to Riches*. Dubai: Makarem.

Masdar.ae
Masdar.ae. 2017. [online] Available at: http://www.masdar.ae/en/masdar-city/detail/masdarcity-downloads. Accessed 26 Nov 2017.

WWF, Abu Dhabi Unveil Plans for Sustainable City
Wwf.panda.org. 2017. *WWF, Abu Dhabi Unveil Plans for Sustainable City*. [online] Available at: https://wwf.panda.org/?121361/WWF-Abu-Dhabi-unveil-plans-for-sustainable-city. Accessed 26 Nov 2017.

Abu Dhabi Emirate: Facts and Figures
Abudhabi.ae. 2017. *Abu Dhabi Emirate: Facts and Figures*. [online] Available at: https://www.abudhabi.ae/portal/public/en/abu-dhabi-emirate/abu-dhabi-emirate-facts-and-figures. Accessed 26 Nov 2017.

The Official Portal of the UAE Government
Government.ae. 2017. *The Official Portal of the UAE Government*. [online] Available at: https://government.ae/en/about-the-uae/fact-sheet. Accessed 26 Nov 2017.

UAE Vision 2021
Vision2021.ae. 2017. *UAE Vision 2021*. [online] Available at: https://www.vision2021.ae/en/our-vision. Accessed 26 Nov 2017.

Sustainable Environment and Infrastructure
Anon. 2017. [online] Available at: https://www.vision2021.ae/en/national-priority-areas/sustainable-environment-and-infrastructure. Accessed 26 Nov 2017.

Competitive Knowledge Economy
———. 2017. [online] Available at: https://www.vision2021.ae/en/national-priority-areas/competitive-knowledge-economy. Accessed 26 Nov 2017.

Government of Dubai
A Sustainable Dubai
Government of Dubai. 2016. *A Sustainable Dubai.* [online] Dubai, UAE: Dubai Municipality. Available at: https://www.dm.gov.ae/wps/wcm/connect/ef0b412e-e8fe-480b-9c37-fa103cf491aa/compressed_DM+Report+-+Low-res+Single+Pages+%28Secured%29.pdf?MOD=AJPERES. Accessed 26 Nov 2017.

Khaleej Times
Dewa Awards Dh1.47b Power Plant Expansion Contract
Khaleej Times. 2015. *Dewa Awards Dh1.47b Power Plant Expansion Contract.* [online] Available at: https://www.khaleejtimes.com/business/local/dewa-awards-dh1.47b-power-plant-expansion-contract. Accessed 26 Nov 2017.

The Seven Emirates
Government.ae. 2017. *The Sven Emirates*. [online] Available at: https://government.ae/en/about-the-uae/the-seven-emirates. Accessed 26 Nov 2017.

WWF Global
WWF, Abu Dhabi Unveil Plan for World's First Carbon-Neutral, Waste-Free, Car-Free City
WWF Global. 2008. *WWF, Abu Dhabi Unveil Plan for World's First Carbon-Neutral, Waste-Free, Car-Free City*. [online] Available at: http://wwf.panda.org/wwf_news/?121320/WWF-Abu-Dhabi-unveil-plan-for-worlds-first-carbon-neutral-waste-free-car-free-city. Accessed 26 Nov 2017.

Ouroussoff, N.
In Arabian Desert, a Sustainable City Rises
Ouroussoff, N. 2010. In Arabian Desert, a Sustainable City Rises. *The New York Times*. [online] Available at: http://www.nytimes.com/2010/09/26/arts/design/26masdar.html. Accessed 26 Nov 2017.

Masdar
Masdar City Factsheet
MASDAR. 2017. *Masdar City Factsheet*. [online] Abu Dhabi: Masdar. Available at: http://masdar.ae/assets/downloads/content/270/masdar_city_fact_sheet-final-23-03-2017.pdf. Accessed 26 Nov 2017.

Fosters+Partners
World's First Zero Carbon, Zero Waste City in Abu Dhabi
Fosters+Partners. 2007. *World's First Zero Carbon, Zero Waste City in Abu Dhabi*. [online] Available at: https://www.fosterandpartners.com/news/archive/2007/05/world-s-first-zero-carbon-zero-waste-city-in-abu-dhabi/. Accessed 26 Nov 2017.

The Economist
Masdar Plan
The Economist. 2008. Masdar Plan. *Technology Quarterly: Q4 2008*. [online] Economist. Available at: http://www.economist.com/node/12673433. Accessed 26 Nov 2017.

MIT News Office
New Model from Masdar Institute-MIT Collaboration to Support a Cooler, More Sustainable Abu Dhabi
MIT News Office. 2016. *New Model from Masdar Institute-MIT Collaboration to Support a Cooler, More Sustainable Abu Dhabi*. [online] Available at: http://news.mit.edu/2016/masdar-institute-mit-collaboration-support-cooler-sustainable-abu-dhabi-0517. Accessed 26 Nov 2017.

Siemens-Masdar
Abu Dhabi and Siemens Intensify Alliance Through a Strategic Partnership with Masdar
Siemens-Masdar. 2010. *Abu Dhabi and Siemens Intensify Alliance Through a Strategic Partnership with Masdar*. [online] Available at: https://www.siemens.com/press/pi/AXX20101006e. Accessed 26 Nov 2017.

Irena Renewable Energy Targets
Irena.org. 2017. *IRENA Renewable Energy Targets*. [online] Available at: http://www.irena.org/-/media/Files/IRENA/Agency/Events/2017/Apr/26/8-Session-II-Renewable-Energy-Target-Setting-and-Support-Schemes-Hannes-Reinisch.pdf?la=en&hash=58319E5E45C417E6466C5C362ED9B0FD9096329A. Accessed 26 Nov 2017.

Kingsley, P.
Masdar: The Shifting Goalposts of Abu Dhabi's Ambitious Eco-City
Kingsley, P. 2013. Masdar: The Shifting Goalposts of Abu Dhabi's Ambitious Eco-City. *Wired*. [online] Available at: http://www.wired.co.uk/article/reality-hits-masdar. Accessed 27 Nov 2017.

Goldberg, S.
Masdar's Zero-Carbon Dream Could Become World's First Green Ghost Town
Goldberg, S. 2016. Masdar's Zero-Carbon Dream Could Become World's First Green Ghost Town. *The Guardian*. [online] Available at: https://www.theguardian.com/environment/2016/feb/16/masdars-zero-carbon-dream-could-become-worlds-first-green-ghost-town. Accessed 27 Nov 2017.

About Mubadala | Mubadala
Mubadala.com. 2017. About Mubadala | Mubadala. [online] Available at: https://www.mubadala.com/en/who-we-are/about-the-company. Accessed 27 Nov 2017.

International Monetary Fund, Middle East and Central Asia Department
Update Middle East, North Africa, Afghanistan, and Pakistan
International Monetary Fund, Middle East and Central Asia Department. 2017. *Update Middle East, North Africa, Afghanistan, and Pakistan. World Economic and Financial Surveys, Regional Economic Outlook*. [online] International Monetary Fund, p. 6. Available at: https://www.google.com/url?sa=t&rct=j&q=&esrc=s&source=web&cd=3&ved=0ahUKEwjc4NauvN3XAhVj1oMKHRE2Cu0QFggxMAI&url=https%3A%2F%2Fwww.imf.org%2F~%2Fmedia%2FFiles%2FPublications%2FREO%2FMCD-CCA%2F2017%2FMay%2Fpdf%2Fmenap0517.ashx&usg=AOvVaw3W8pkQziMvasg_M0fbKCQR. Accessed 27 Nov 2017.

Everington, J.
The UAE, and Abu Dhabi and Dubai in Particular, Are Leading the Way When It Comes to Implementing Green Building Practices
Everington, J. 2013. The UAE, and Abu Dhabi and Dubai in particular, are leading the way when it comes to implementing green building practices. *The National*. [online] Available at: https://www.thenational.ae/business/1.288335. Accessed 27 Nov 2017.

United Arab Emirates Civilization
National Archives UAE. 2017. *United Arab Emirates civilization*. [online] Available at: http://www.na.ae/en/archives/historicalperiods/civilization.aspx. Accessed 27 Nov 2017.

Portuguese Era, Dutch Era, British Era
———. 2017. *Portuguese Era, Dutch Era, British Era*. [online] Available at: http://www.na.ae/en/archives/historicalperiods/emirateserasofcivilization.aspx. Accessed 27 Nov 2017.

Wake, V.
The City That Grew Out of a Desert
Wake, V. 2010. The City That Grew Out of a Desert. *Australian Quarterly*, [online] 82(1). Available at: http://www.jstor.org/stable/23215312. Accessed 27 Nov 2017.

Heard-Bey, F.
From Trucial States to United Arab Emirates
Heard-Bey, F. 1999. *From Trucial States to United Arab Emirates*, 284–297. London: Longman.

The National
Significant Dates in UAE history
The National. 2012. Significant dates in UAE history. [online] Available at: https://www.thenational.ae/uae/significant-dates-in-uae-history-1.357047. Accessed 27 Nov 2017.

Index[1]

[1] Note: Page numbers followed by 'n' refer to notes.

R. Brinkmann, S. J. Garren (eds.), *The Palgrave Handbook of Sustainability*,
https://doi.org/10.1007/978-3-319-71389-2

E

G