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Lifelong Learning and Education in Healthy and Sustainable Cities

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Lifelong Learning and Education in Healthy and Sustainable Cities

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Editorial

This book aims at bringing the knowledge about the theme of lifelong learning and education for sustainable development and intends to be a contribution to the implementation of Sustainable Development Goals (SDGs) considering the broad field in which it is inserted.

The interface between environment, health, and lifelong learning is fundamental to achieve the sustainable development agenda that highlights critical links between development, the environment, human well-being and the full enjoyment of a wide range of human rights, including the rights to life, health, food, water, and sanitation. It is increasingly evident that due to the rapid demographic development as well as ecological and social challenges, global sustainability goals can no longer be reached without an active role of the cities.

Considering the broad field of topics associated with SDGs, this book is divided into seven distinctive parts: The first is related to the topical issue of Sustainable Cities and then deepens to urban planning in order to address inequality and the effects of climate change. The second part focuses on Healthy Cities and Healthy Environments in order to better understand how cities can be built in harmony with nature thereby connecting cities, rural areas, and with sustainability thinking. The third part focuses on Governance for Sustainable Development through education and the implementation of agendas for the development of healthy cities and environments. The fourth part focuses on the social determinants of health oriented to the SDGs. The fifth part focus on Education and Lifelong Learning for Sustainability, through a multidisciplinary approach presenting the relationship between individual and collective learning. The sixth part focuses on Sustainable Cities; Sustainable Buildings; and Sustainable Infrastructure. The final part of this book concentrates on Energy Security, Access, and Efficiency.

A total of 35 double-blind peer-reviewed papers from Europe (10), Asia (2), Africa (1), North America (4) and South America (18), cover the different subjects related to the above themes of this book.

In the first part of the book, which is related to Sustainable Cities, readers can find four.

The first chapter from Luiz Priori Jr., Marcelo Hazin Alencar, and Adiel Teixeira de Almeida, is entitled; “Coping with Climate Change Effects on Urban Infrastructure—Problem Structuring Based on Value-Focused Thinking Methodology”. This chapter focuses on the effects of global climate change on urban settlements and emphasizes the importance of including climate change mitigation strategies in the planning and management of sustainable urban environments. It suggests a methodology using Value-Based Thinking (VFT) in order to assist in decision-making for governments and communities and is based on seeking to ensure that available resources are implemented in a coherent way.

In the chapter; “Participatory GIS for Urban Sustainability and Resilience: A Perspective of Social Learning and Ecology of Knowledge”, Carolina Monteiro de Carvalho and Leandro Luiz Giatti reinforce the potential of Participatory Geographic Information Systems (PGIS) in terms of promoting learning and social participation in the quest for environmental sustainability in cities. The authors argue that the tool has great potential for educating and empowering citizens, providing better governance and urban settings and, therefore, promoting healthier and more resilient cities.

João Soares, Leila dal Moro, Ulisses Azeiteiro, and Luciana Brandli’s chapter entitled; “The Regional Development Councils of Rio Grande do Sul as a Model of Participated Regional Management. Comparative Case Study”, comparatively analyze the development and application of the Sustainable Development Goals in the region of COREDE, located in Rio Grande do Sul—Brazil and the region of Basilicata—Italy.

In chapter; “Participation in Spatial Planning for Sustainable Cities: The Importance of a Learning-by-doing Approach”, Ann Crabbé, Anne Bergmans, and Marc Craps presents the notion of slow urbanism as an appropriate approach to urban planning processes in order to effectively contribute to the creation of safer, more sustainable and resilient cities. Implementing slow urban planning principles can work for city development and build resilience in case of unexpected (sudden) events. In addition, the authors provide guiding principles for participatory co-creation processes that facilitate social learning in spatial planning processes, such as: (1) organizing participation in the early stages (pre-draft), (2) a facilitating government, aware of the relevance of a reflexive approach and (3) a learning-by-acting in the implementation of new and innovative solutions (spatial).

In chapter; “The Urban Planning Guided by Indicators and Best Practices: Three Case Studies in the South of Brazil”, Vanessa Rocha, Luciana Brandli, Rosa Kalil, and Cristiane Tiepo, addresses the importance of integrated learning (university versus community) in the transformation of cities into healthy environments. First, three polo cities in Southern Brazil were analyzed through urban planning indicators that contribute to a healthier environment. Secondly, successful case studies were carried out at both national and international levels, aiming at the sustainable transformation of cities, analyzing the applicability of the cases to the municipalities studied. Thirdly, interactions with the selected communities, including discussions and learning, were conducted in the face of more sustainable urban planning techniques. The results revealed problems in the current urban planning, especially

in areas and indices of green coverage which are healthy indicators of the urban environment. In addition, and in order to combat climate change and to develop resilience; the inclusion and participatory monitoring of urban planning indicators were seen as essential factors for good management and quality of life in cities.

The second part of the book concerns Healthy Cities and Healthy Environments.

In chapter; "Nature, People and Place: Informing the Design of Urban Environments in Harmony with Nature Through the Space/Nature Syntax", Karen Munro and David Grierson, address the dichotomy between the psychological, physical, and emotional benefits nature offers and the growth of the world's urban population. How do we maintain this vital and valuable human connection with nature in an increasingly urbanizing world? Based on previous preliminary publications, this chapter will update the findings of a new interdisciplinary methodology called Space/Nature Syntax, which was developed and applied in the Arcosanti "urban laboratory" in the Arizona desert, United States. The findings, which support the relationship between visual connectivity, nature and certain social interactions, present a unique understanding of nature's influence on human interactions with other people and places. The findings also present how the informed design can satisfy the biophilic need and allow the human and essential nature connection to develop, thereby taking steps to understand how cities can be built in harmony with nature.

In chapter; "Public Policies to Live Well (Buen Vivir) in Harmony with Nature", Vanessa Hasson de Oliveira aims to contribute to a paradigm shift in law and society, abandoning the anthropocentric perspective in favor of affirmative polycentric bio-politics. For the successful implementation of the proposal, the author deals with the Law of Universal Fraternity by the practice of the action of loving that prevails regardless of law enforcement and becomes immanent throughout the entire legal system.

Marco Akerman, Rosilda Mendes and Francisco de Assis Comarú's chapter entitled; "Health and the Urban: Multiple Threads Interconnecting Health in the City", emphasize that urban scenarios are based on problems due to the changes that drive the historical transformations of society, such as increasing urbanization, and the impact on morbidity and mortality rates and the health status of the population. The relationship between "health" and "urban" was analysed with six global agendas. As a result of the analysis, health as a topic emerges in these plans with multiple interfaces, such as; health and environment; migration and health; access to health services; local governance; urban planning and policies; violence; poverty and vulnerability; and equity in health. Some see urban areas as a determinant of health and pursue a basis of evidence for interconnection, while others see health as a weak link to potentially harmful urbanization. There are still many questions regarding the operational framework that crosses health and cities among selected global agendas.

Veruska Prado Alexandre, Claudia Job Schmitt, and Renato Sérgio Jamil Maluf introduce the complex relationships that connect food, health, and the environment at the heart of contemporary food policy in the chapter; "Making Rural and Urban Connections by Integrating Nutrition and Agriculture: A Case Study of Food and

Nutrition Security Instruments". Healthy food based on sustainable food systems is an important component for connecting cities, rural areas, and sustainability, and is permeated by multiple determinants that require the use of integrated public policy instruments. The authors discuss two of these instruments extracted from the historical construction of a political agenda of the Food and Nutrition Security (FSN) in Brazil: the National School Meal Program (NSMP) and the Brazilian Food Guide (BFG). It analyses how the healthy food and nutritional tools link agriculture and nutrition, and how they define relationships with the notion of sustainability.

Artie Ng, Ben Fong and Tiffany Leung, in the chapter entitled; "Health and Sustainability: Reinforcing Public and Private Engagement through Tertiary Institutions", propose a conceptual framework relating health and sustainability as responsible actions for the public and private sectors. Exploring the case of Hong Kong as an international city and financial centre, a social science approach was adopted to analyse strategies for health promotion and sustainability. It was found that if accountability is to serve public interests, it should be extended to incorporate the underlying social and health costs associated with the lack of environmental sustainability. Tertiary institutions, including universities, could play a strategic and moderating role as an independent centre to integrate the efforts of government, the business sector and communities, in general, could also enable a dynamic process of health, sustainability and quality of life through recurrent learning, teaching, and research.

The third part of the book concerns Governance for Sustainable Development.

In chapter; "Using the IPBES Conceptual Framework to Study Governance, Institutional Arrangements and Drivers of Biodiversity Loss in two Indian Cities", Sandhya Chandrasekharan adopts the conceptual framework offered by the Intergovernmental Platform on Biodiversity and Ecosystem Services (IPBES) to examine the theme of the Convention on Biological Diversity (CBD) of Cities and Biodiversity in the Indian metropolitan cities of Chennai and Bengaluru. These cities, with populations already comparable to those of the largest urban agglomerations worldwide, face governance challenges related to biodiversity and ecosystems. The research was delineated to explore the institutional architecture and the levels of awareness of biodiversity and ecosystem services. In this context, the real estate housing industry has emerged as a key player in the evolving landscape in these areas.

Maria Cristina Franceschini, Elisabete Agrela de Andrade, and Karina Cimmino, in chapter; "Healthy Cities, Healthy Settings and Education: How do They Work Together to Promote Sustainable Development?" discuss some of the existing agendas for the development of healthy cities and environments, as proposed by the World Health Organization (WHO). They consider the Salutogenic model as an option to promote a paradigm shift towards models that produce life and health at the territorial level. The authors reflect on the role that education can play in the development of healthy and sustainable environments and how education can contribute to an emancipatory and health promoting practice for sustainable development. This highlights some of the connections that need to be built within a context of multiple fragmentations of concepts, agendas, sectors, values, and power.

In chapter; “Education for Sustainability as a Tool to Promote Sustainable Development: An Experience in the South of Brazil”, Cristiane Tiepo, Luciana Brandli, Rosa Kalil, and Vanessa Rocha presents the research that was carried out in three cities of Rio Grande do Sul, Brazil (Passo Fundo, Porto Alegre, and Santa Maria), with the aim of empowering citizens in education for sustainability. As a result, it was possible to identify that few citizens know about important participatory channels, such as “Popular State Consultation”. Individuals active in resident associations and nongovernmental organizations do not have sufficient power to participate in Deliberative Municipal Councils, Public Hearings, courses and training projects, thereby reinforcing the importance of education for sustainability as a tool to enhance local governance.

In chapter; “Right to the City and Public Policies: Current Perspectives of the Judicialization of Environmental Sanitation Policies in Brazil”, Lorena Sales Araújo and Patrícia Borba Vilar Guimarães analyse the challenges of the contemporary city emphasizing its urbanization process and the need to guarantee the right to the city to all adopting the principle of sustainability and the concept of intelligent cities. The authors present how the Brazilian higher courts have positioned themselves in the recognition of the right to the city, as a fundamental right. They analyse a leading case of the Brazilian jurisdiction on the compulsory implementation of public policies in order to improve the quality of the water supply system and sanitary sewage.

In chapter; “Remote but Connected: Ownership-Inspired Behavior-Driven Development [OIBBD] and What an e-learning Governance System for Africa Could Look Like”, Judith Gottschalk and Nicolai Winther-Nielsen present OIBBD, a development strategy designed for e-learning governance in remote areas in Africa to support sustainable education as part of the 2030 Agenda and the Sustainable Development Goals (SDG). It has been found that the use of e-learning technology is one of the keys to the development of sustainable education in urban and remote areas in West Africa. This is due to the reduced demands of students who are well integrated into their rural society. Leadership in this area, and the empowerment in African teachers, can lead to develop ownership in the use of e-learning technology and thus contribute to the achievement of SDG.

In the fourth part of this book, the focus is on the Social Determinants of Health Oriented to Sustainable Development Goals.

Marcia Westphal, Maria Franceschini and Andréia Setti, in their chapter; “How can the Healthy Municipalities, Cities and Communities Strategy Advance the Sustainable Development Goals Agenda? Lessons from Agenda 21 and the MDGs in Brazil”, examine that the Healthy Municipalities, Cities and Communities (HMC) has the potential to link national and international agendas, such as SDG, based on the real needs of the territory and its population. The HMC networks, which are present across the American continent, can play a key role in this process because of its capillarity and potential to mobilize actors at various levels. They can also be strategic in promoting the empowerment and education process to strengthen communities’ capacity to promote sustainable action.

In chapter; "Sustainable Development Goals as a Framework of Education for Healthy Cities and Healthy Environments", Marija Jevtic and Catherine Bouland present the Education as a powerful tool for contribution to urban health that can drive us to the achievement of SDGs. And vice versa, the SDGs should present a framework for curricula and contribute to literacy, raising awareness, and contribute to excellence in various professions.

Roberto de Almeida and Patrícia Carvalho, in chapter; "Healthy People Living on a Healthy Planet—The Role of Education of Consciousness for Integration as an Instrument of Health Promotion", present the Integrative Health approach to the socio-environmental responsibility. This has been applied in the context and experience of Itaipu Binacional—Cultivating Good Water program for health awareness and promotion through the articulation of human needs related to the multidimensional aspects of health, social life, natural environment, and sustainable development. Based on awareness education, the expected result of the Integrated Health Promotion is an increase in the social capital of communities and a greater commitment to the values and principles of a new human logic, that of Homo sustentabilis. Educating awareness regarding integrative health principles facilitates learning how to take care of yourself, others, and the environment.

In chapter; "Achieving Sustainability in the City of Winona, Minnesota (USA): A Case Study", the authors Bruno Borsari, Neal Mundahl, Anne Morse, Pat Mutter and John W. Howard present the challenges and opportunities to pursue sustainable development in Winona, Minnesota, USA, and is based on seven SDGs, specifically: urban agriculture, composting, parks and green-field conservation, urban landscaping to attract species of pollinators, water quality, sustainable tourism, and recycling.

In chapter; "Education and Lifelong Learning Sustainability: Windows of Opportunities Found in Brazilian Experiences that Address Agenda 2030 and Advocacy for Health Equity", Dais Gonçalves Rocha, Maria Paula Zaitune propose the fulfillment of the Sustainable Development Objectives, creating a dialogue between the literature and the successful experiences found in Brazil. These experiences are inter-sectorial actions and urban planning strategies linked to the international agendas for health promotion and SDGs.

In the fifth part of this book, the focus is on Education and Lifelong Learning for Sustainability.

Jean-Pierre Schweitzer and Susanna Gionfra, in the chapter; "Nature-based Education for Resilient Cities", addresses nature-based education with green infrastructure (GI), including protected areas which present an opportunity in the context of the environmental and socio-economic challenges faced by urban citizens.

Petra Kuenkel and Alina Gruen in their chapter; "Co-creation for Sustainability as a Societal Learning Journey", explore the relationship between lifelong individual and collective learning, with a particular focus on learning in multi-stakeholder collaboration, that enhances systemic change towards sustainability. The authors suggest a methodology—the Collective Leadership Compass—as a guiding tool for transformational change processes in multi-stakeholder collaboration.

Adriana Gelpi, Rosa Maria Locatelli Kalil, Wagner Mazetto de Oliveira, in the chapter; "Lifelong Education: Citizenship Lessons for Life in more Sustainable Communities?", analyse the integration and implementation of concepts of urban planning and sustainability in the school community.

In chapter "Live-long Learning as a Sustainability Strategy", Christopher A. Haines explores why we need to start with understanding ourselves and our thinking, and then how we should turn it into a lifelong learning attitude in order to progressively expand our knowledge and expand our capacity to regenerate society and our built environment.

Chris Willmore, James Longhurst, William Clayton, Hannah Tweddell, and Amy Walsh in the chapter; "Young People's Role in Creating Sustainable Cities", draw upon the award-winning Bristol Green Capital: Student Capital research data, the Bristol Learning City project and well-being, and relational thinking literature. This is done in order to explore the relationships between SDG 4, "learning, engaged activity and well-being", and "the significance of partnerships", SDG17, as an outcome in its own right. They argue that the capacity of young people to play a role in SDG11, "developing city sustainability" is undervalued.

In chapter; "Climate Change, Education for Sustainable Development in Urban Educational Landscapes and Learning Cities. Experiences and Perspectives From Osnabrück", Gerhard Becker presents a model of sustainable development in six dimensions as a theoretical basis, with education as an independent dimension, and applies this model to the thematic area of climate change education for sustainable development (CCESD) in the city Osnabrück, Germany.

Carolina Sampaio Marques, Nathália Rigui Trindade, Rodrigo Reis Favarin, Suelen Geíse Telocken and Marcelo Trevisan, in the chapter; "Institutional Management and Teacher Perception in Strengthening Education for Sustainability", addresses Sustainability Education, and focuses on transformative approaches to the integration of principles sustainable development.

In the sixth part of the book, the focus is on Sustainable Cities & Sustainable Buildings and Sustainable Infrastructure.

In chapter; "Promoting Sustainability: The Role of Smart Cities", Madhavi Venkatesan focuses on the economic elements that both promote and enable sustainability consistent with the attribution of a smart city. Quality of life parameters, along with intergenerational resource allocation and ecosystem preservation, are assumed as a focus in the implementation of consumer education programs targeted as a foundation for smart economic development.

In chapter "How Technologies Contribute to Urban Sustainability: The Case of Curitiba—Brazil", Paola Saraiva, Lauro Ribeiro, Inara Camara, and Thaísa da Silva evaluate the city of Curitiba, the capital of the state of Paraná (Brazil), and considers a model of intelligent Brazilian city focusing on physical, social, institutional, and economic infrastructure in an innovative sustainable development.

In chapter; "Communication as a Tool for Expanding Social Participation: The Case of the Rio Operations Center", Alexandre Hojda and Pedro Reis Martins highlight the relationship between the use of Information and Communications Technology (ICT) and the social participation in the city of Rio de Janeiro. Through

the social and midiatic engagement strategy of Rio Operations Center, an urban command and control centre launched in 2010 to assist the logistic city management, the authors present four perspectives on the communications strategy: (1) press companies engagement in the city's operational routine; (2) the use of web-based social media tools to engage citizens; (3) partnerships with urban mobility mobile applications and (4) live video broadcasts on the internet to communicate crisis situations.

In chapter; "Sustainable Housing Through Sustainable Planning Practices: Challenges and Opportunities for Formal Housing Provision in Nairobi, Kenya", Collins Sasakah Makunda evaluate the rapid population growth and urbanization in Nairobi, Kenya. This growth has resulted in enormous pressures on the city's urban infrastructure, chiefly in the transformation of the low-rise single family housing units, mostly bungalows, to high-rise multi-family housing units, in the form of high-rise apartment blocks.

In chapter; "Yueqing's Healthy Future: A Case Study in Design Planning for Healthy Urbanization", Linda Powers Tomasso, Cristina Contreras Casadoc, Judith Rodriguezc, Jie Yina, and Julia Kane Africab analyse urban health in a context of regional population transition in China. The themes in this chapter include; resilience of urban climate change, urban mobility, and strategies for healthier buildings to optimize urban health, and long-term sustainability in the process of urban growth and development. The authors focus on how China's economic ascendancy can facilitate more sustainable models of future urban development.

In the final part of the book, the focus is on Energy Security, Access, and Efficiency.

In chapter; "Greening of Greek Islands: Community Wind Approach at Skyros Island", Constantina Skanavis and Aristea Kounani examine how attitudes of the inhabitants of an Aegean island towards wind energy can be affected by community ownership of the wind. Skyros Island was chosen as the region where a giant wind farm investment was being proposed, however after opposition from the inhabitants, the facility was delayed. The author's assess whether community owned wind power increases residents' acceptance of small-scale wind farms as a solution to the island's energy sufficiency and overall sustainability encouragement.

Amanda Lange Salvia, Luciana Londero Brandli and Marcos Antonio Leite Frandoloso, in their chapter; "Prerequisites for Energy Sustainability in Municipalities in Rio Grande do Sul, Brazil", discuss the energy matrix and the electricity consumption in Southern Brazil. The study presents the results of the energy work package on the project prerequisites for the sustainability of municipalities in Rio Grande do Sul.

Last but not least, in chapter; "Public Energy Policy in Cabo Verde", Luzia Mendes Oliveira uses quantitative methods to understand how knowledge, attitudes, practices, and perceptions of citizens may influence the viability of the strategy to achieve 100% of electricity production from renewable sources, by 2020 in Cabo Verde. It concludes that, although the new policy has the necessary conditions to succeed, specific socio-demographic factors should be considered in order

to; reduce national Greenhouse Gas emissions, improve the security of supply, alleviate poverty, and achieve nationwide access to electricity.

Given the variety of research, this book offers a diverse thematic, multidisciplinary, and geographic diverse overview of some current research and action projects in Lifelong Learning and Education in Healthy and Sustainable Cities. In addition, the chapters address some important challenges to the achievement of the SDGs. Furthermore, the book gives critical insights to the discussion around at multiple spatial, temporal and socio-political scales, and the multiple dimensions of the SDG practiced, in a multidisciplinary dialogue.

We would like to take this opportunity to thank all the authors who submitted their manuscripts for consideration of inclusion in this book. Additionally, and since the peer-review was a double-blind process, we also thank the reviewers who have taken time to provide timely feedback to the authors, thereby helping the authors to improve their manuscripts, and ultimately the quality of this book.

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Part I
Urban Planning to Address Inequality in Health and Urban Poverty

Coping with Climate Change Effects on Urban Infrastructure—Problem Structuring Based on Value-Focused Thinking Methodology

Luiz Priori, Marcelo Hazin Alencar and Adiel Teixeira de Almeida

Abstract This paper focuses on effects of global climate change on urban settlements and subsequently need to raise the level of resilience and diminish vulnerability of cities in terms of their natural and constructed environments so as to mitigate risk of urban disasters. Due to population concentration, cities are locations where the occurrence of disasters often causes the most damage, it is important to include climate change mitigation in planning and management of sustainable urban environments, especially since forecasts point to a growing urbanization of undeveloped world's population. It will be presented a framework for creation of alternatives to climate change mitigation based on Value-Focused Thinking (VFT) methodology, which makes the decision-making process more consistent and effective since it generates alternatives to deal with the need to mitigate climate change in order to cope with environmental disasters, thereby contributing to urban planning policy. By developing a framework to assist in decision-making, and basing it on seeking to ensure that available resources are coherently implemented, this study contributes to improving sustainable urban development. In order to illustrate how to analyze this type of problem, a proposed framework was applied in the city of Recife, the capital of the Brazilian state of Pernambuco.

Keywords Climate change · Urban infrastructure · Value-Focused Thinking (VFT) · Decision-making

1 Introduction

According to a report from the United Nations' High-Level Panel on Global Sustainability, (part of the United Nations Environment Programme), climate change is a risk to people in all countries and a particularly serious risk to the world's poorest populations (UNEP 2012).

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Several authors (Lee and Hughes 2016; Rohat et al. 2016; Priori et al. 2016; Cramer and Karabell 2010; Beatley 2009) discuss the growth of the world's population and its associated impacts, such as increased urbanization. They forecast that by the year 2050, 70% of the world's population will live in urban environments. Moreover, this increase will occur mainly in less-developed regions of the planet.

The report entitled State of the World's Cities 2012/2013 (UN-Habitat 2013) announces that by 2015 there will be 477 cities with a population of between one and five million inhabitants, 43 cities with between 5 and 10 million inhabitants, 21 cities with between 10 and 20 million inhabitants and six cities with more than 20 million inhabitants.

Furthermore, most of these cities are located in less-developed countries and many present two serious problems that are part of their daily life: flooding and landslides (Chelleri et al 2015; Walters 2015). As a result of the large volumes of surface water from heavy and/or prolonged rains, together with drainage deficiencies and the erosion of hill-sides, metropolises—especially those located in developing countries—are very often at risk of flooding. These risk factors are likely to increase with climate change (Priori Jr. 2013).

It is important to stress that metropolitans' infrastructure systems are highly vulnerable to disasters. However, these systems are of vital significance for emergency response and to the quick recovery of the community and its economy (Procyk 2010a, b; Yu 2010). Therefore, the planning of sanitation, energy, communications, and transportation systems must be able to forecast potential failures. These can then be reduced through redundancy planning and back-up measures, thus diminishing the vulnerability of built structures in a way that is least harmful to society (World Bank 2013).

Moreover, urban infrastructure systems, such as electric power, transportation, and others, in addition to being vulnerable, are also interdependent. Hence, city planners need to consider multiple disaster sources, methods of system failure, and the cascading interdependencies among these systems, as well as the many potential alternative procedures that could diminish failure risk within and across the systems (Chang et al. 2014).

According to de Almeida et al. (2015), in this type of context, it is necessary to simultaneously consider multiple objectives to structure and identify objectives and establish sets of alternatives for multi-criteria decision-making.

This paper presents a framework for analysing urban infrastructural resilience to the potential impacts of climate change based on Value-Focused Thinking (VFT) methodology, particularly with regard to the six key elements that make up urban infrastructure, namely: energy, sanitation, waste, transport, communication, and buildings (Priori Jr. 2014).

Although urban resilience includes the individual city context, cities have characteristics in common that enable this framework to be applied in practically any urban agglomeration—which suffers from problems related to extreme hydrological events—with the goal of generate alternatives that decrease vulnerability and augment urban resilience to the risk from disasters, contributing to the mitigation and adaptation strategies to global climate change.

To illustrate how to analyze this type of problem and to apply the methodology, this article presents how this was done in the city of Recife. According to the last population census in 2010, the city had 1,536,934 inhabitants and the report entitled State of the World's Cities 2012/2013 (UN-Habitat 2013) shows that the population in the metropolitan areas of Recife will increase from 3.871.000 in 2010 to 4.219.000 in 2025.

2 Urban Resilience and the Impacts of Climate Change

Hundreds of millions of urban dwellers in middle-income countries are at risk of suffering direct and/or indirect impacts from climate change. At the same time, several geographic and socioeconomic characteristics of cities may make them more vulnerable to such impacts (Bartlett et al. 2012; Beatley 2009; Gasper et al. 2011; Razafindrabe et al. 2014; Wilde and Coley 2012). For example, cities that are located on the coast are difficult to drain without the use of pumps. Moreover, high tides and/or storms can hinder water drainage into the sea and cause prolonged flooding, sometimes with polluted floodwater, which can aggravate urban health problems. The effects of climate change might increase the occurrence and frequency of heavier rains, which can make the floods less predictable (Tingsanchali 2012).

In communities with the potential for disaster risk, resilience is inversely related to vulnerability; that is, more resilience equals less vulnerability. Resilience is shaped by vulnerability, which in turn incorporates the adaptive capacity (Adger et al. 2005a, b; Adger and Vincent 2005; Birkmann 2006; Brooksa et al 2005; Confort et al. 2012; Gallopín 2006; Pelling 2011; Smit and Wandel 2006; UNISDR 2012; Walker and Salt 2006; World Bank 2012).

Resilience is the capacity of systems to cope with a hazardous event or disturbance, reorganizing in ways that maintain their essential function and structure, while maintaining the capacity for adaptation and transformation, whilst vulnerability is defined as "the propensity or predisposition to be adversely affected, and encompasses a variety of concepts and elements including sensitivity or susceptibility to harm and lack of capacity to cope and adapt". (IPCC 2014:5).

The term "resilience" can be applied to cities, as they must respond to crises and adapt to hazards. Cities require strong physical structures and a sturdy built environment (Baker 2012; Newman et al. 2009; PROVIA 2013). For Godschalk (2003), resilient cities are built to be strong and flexible rather than brittle and fragile.

3 Framework for Analysing Urban Resilience to the Impacts of Climate Change

The framework for analysing urban resilience to the impacts of climate change, resulting from extreme hydrological events, consists of four steps, as shown in Fig. 1.

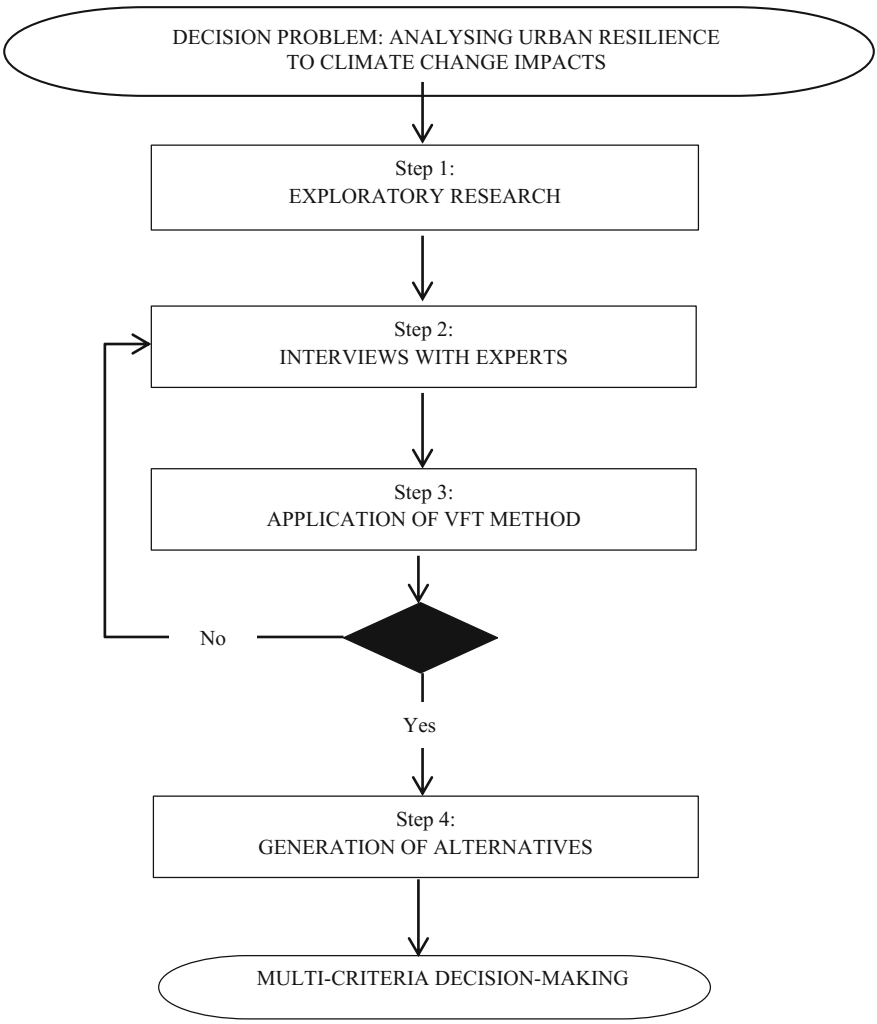

Fig. 1 Framework for analysing urban resilience to the impacts of climate change

3.1 Exploratory Research—Step 1

A baseline study helps to deepen an understanding of urban vulnerability in relation to the resilience to the impacts of climate change. This is achieved by exploratory research through direct observation, which aims to identify (in situ) and document aspects that corroborate any increase in vulnerabilities in the infrastructure of the neighborhoods. It is important to analyze if these vulnerabilities are similar to each other before considering how the city as a whole should be perceived.

3.2 Interviews with Experts—Step 2

The data collected in the exploratory research should be analysed by experts in urban systems, who may be university research staff and highly experienced public and/or private sector professionals. These consultants should also answer a semi-structured questionnaire formulated to stimulate and create ideas and thereby to generate alternatives, as shown in the model in Table 1.

3.3 Application of VFT Method—Step 3

According to Morais et al. (2013), VFT provides a systematic approach to structuring complex decisions and for their subsequent analysis. It is an important methodology which contributes with significant insights for decision-making. The idea is to generate viable alternatives which are in accordance with the values of the decision makers involved, with aiming to help in the solution of decision problems under study.

Table 1 Interview guide Adapted from Alencar et al. (2011)

1	What is your perception of the problem?
2	What problems are occurring because of natural disasters?
3	What desirable situations would be possible (even hypothetically)?
4	What undesirable situations would be possible (even if hypothetical)?
5	Assuming there are no restriction on the problem (economic restrictions or any other ones), what is your goal for solving the problem in question?
6	Can you identify some consequences associated with this problem?
7	Can you identify some additional concerns associated with this issue?
8	Is there a specific goal to be achieved?
9	Is there any specific restriction to be respected?
10	Could you list some general goals for the treaty subject?

Value-Focused Thinking (VFT) methodology (Keeney 1992) has been applied in a wide range of contexts in order to identify decision-makers' objectives, including in areas such as the Supplier-Quality-Management, military sector, mobile technology, tourist management, when examining terrorists' objectives, issues to do with the environment, and telecommunications management (Alencar et al. 2011; Hassan 2004; Kajanus et al. 2004; Keeney 2001; Keeney and McDaniels 2001; Keeney and Winterfeldt 2010; León 1999; Merrick and Garcia 2004; Merrick and Grabowski 2014; Morais et al. 2013; Sheng et al. 2005; Yoo et al. 2001).

The VFT method is based on values, which, according to Keeney (1996), must be the driving force for this process because they are fundamental to everyday decisions (Fig. 2). Adopting values improves the decision-making process. Three aspects characterize the objectives: (1) the decision context, (2) an object, and (3) a preference direction (de Almeida et al. 2015).

To apply VFT methodology (Fig. 2), it is important to provide a decision-making structure, which consists of acquiring a deep understanding of the context of the subject (item 3.1—step 1 and item 3.2—step 3) and of setting the

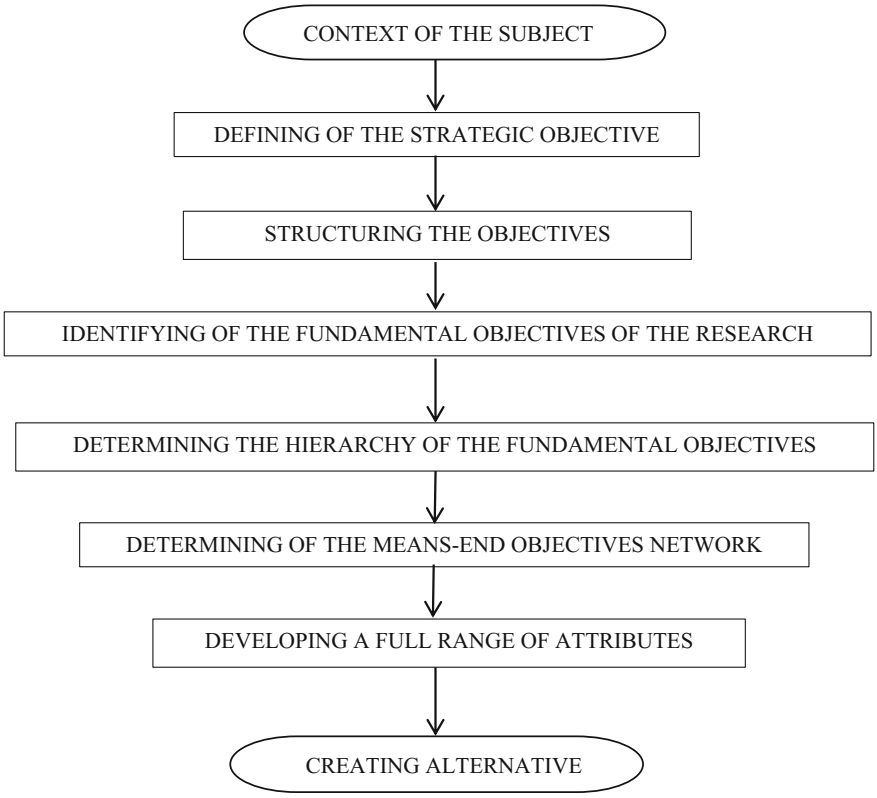

Fig. 2 Steps for the application of the VFT method

strategic objective to be achieved. The context of the problem defines the set of alternatives suitable for consideration in a specific situation. It is important to remember that the core of any decision is the desire to avoid adverse effects and bring about desirable ones (Keeney 1992).

3.3.1 Defining the Strategic Objective

The first action for applying the VFT method is to define the strategic objective, which in the subject under study can be defined as: "Generation of alternative actions for improving the resilience of urban infrastructure for possible impacts of climate change".

The VFT methodology begins by identifying objectives, separating them into fundamental and means categories, and then constructing a hierarchy of fundamental objectives and a network of means-ends objectives. This is intended to elucidate the relationships between all of the objectives (Morais et al. 2013).

3.3.2 Identifying the Fundamental Objectives of the Research

After defining the strategic objective, the next action is to define the fundamental objectives of the research. For this purpose, the urban infrastructure was divided into the six key urban systems, namely, energy, sanitation, waste, transport, communication, and buildings, which were analysed by evaluating their level of robustness, flexibility, modularity, and redundancy, should they experience an extreme hydrological event. Thus, the fundamental objectives, which are designed to meet the strategic research problem, were defined in order to evaluate the elements of urban infrastructure by measuring the resilience capacity of their components (Table 2).

3.3.3 Determining the Means-End Objectives Network

It is important to distinguish between "fundamental objectives" and "means objectives". Fundamental objectives concern the ends that decision-makers value in a specific decision context, while means objectives are the methods to achieve these ends. It is important to bear in mind that ends and means are context dependent. Means objectives can suggest alternatives that will achieve fundamental objectives. Therefore, the next step must be to draw up the network of means-ends objectives.

By way of illustration, Fig. 3 shows the means-end objective network resulting from the perceptions and ideas of the 20 experts interviewed about the resilience of the urban infrastructure to the potential impacts of extreme hydrological events in the city of Recife. These experts were chosen because they develop relevant projects and research in the study area (Table 3).

Table 2 Hierarchy of fundamental objectives

Alternatives to the improvement of urban infrastructure resilience to possible impacts from climate change (strategic objective)
1. Improve the physical structure for power generation and transmission
1.1 Maximize the generation and transmission capacity of electrical power systems 1.2 Maximize the capacity of gas-powered thermal power generation systems 1.3 Maximize the capacity of photovoltaic power generation systems
2. Improve the structure of sanitation systems
2.1 Maximize distribution and treatment of potable water systems 2.2 Maximize distribution and treatment of domestic sewage systems 2.3 Maximize coverage and capacity of macro drainage systems 2.4 Maximize coverage and capacity of micro drainage systems
3. Maximize the coverage and capacity of the municipal waste management structure
3.1 Improve management of organic waste 3.2 Maximize the recyclability of waste 3.3 Maximize the reutilise of construction and demolition waste
4. Improve the structure and capacity of means of transport
4.1 Improve transportation systems 4.2 Improve transport facilities
5. Improve the communication system network
5.1 Maximize the coverage of TV systems 5.2 Maximize the coverage of radio systems 5.3 Maximize the coverture of internet's networks 5.4 Maximize cellphone's networks
6. Improve the structure of buildings and maximize shelters' availability to house people in case of disaster
6.1 Improve the buildings' physical structure 6.2 Maximize the level of accommodation available

The results presented in Fig. 3 were obtained through the analysis of the data found in the field research and the discussions with the specialists (Table 3).

3.3.4 Developing a Full Range of Attributes of the Fundamental Objectives

The achievement of a fundamental objective is measured in terms of an attribute. Therefore, the structure consisted of objectives and attributes that provided the decision-maker with a general idea of the problem situation, which allows them to emphasize higher value alternatives (Keeney 2007; Morais et al. 2013).

These attributes are developed based on discussions with the experts interviewed, outlined in the network of means-end objectives (Fig. 3). Table 4 shows the attributes generated for the assessment of the fundamental objectives applied to the city of Recife.

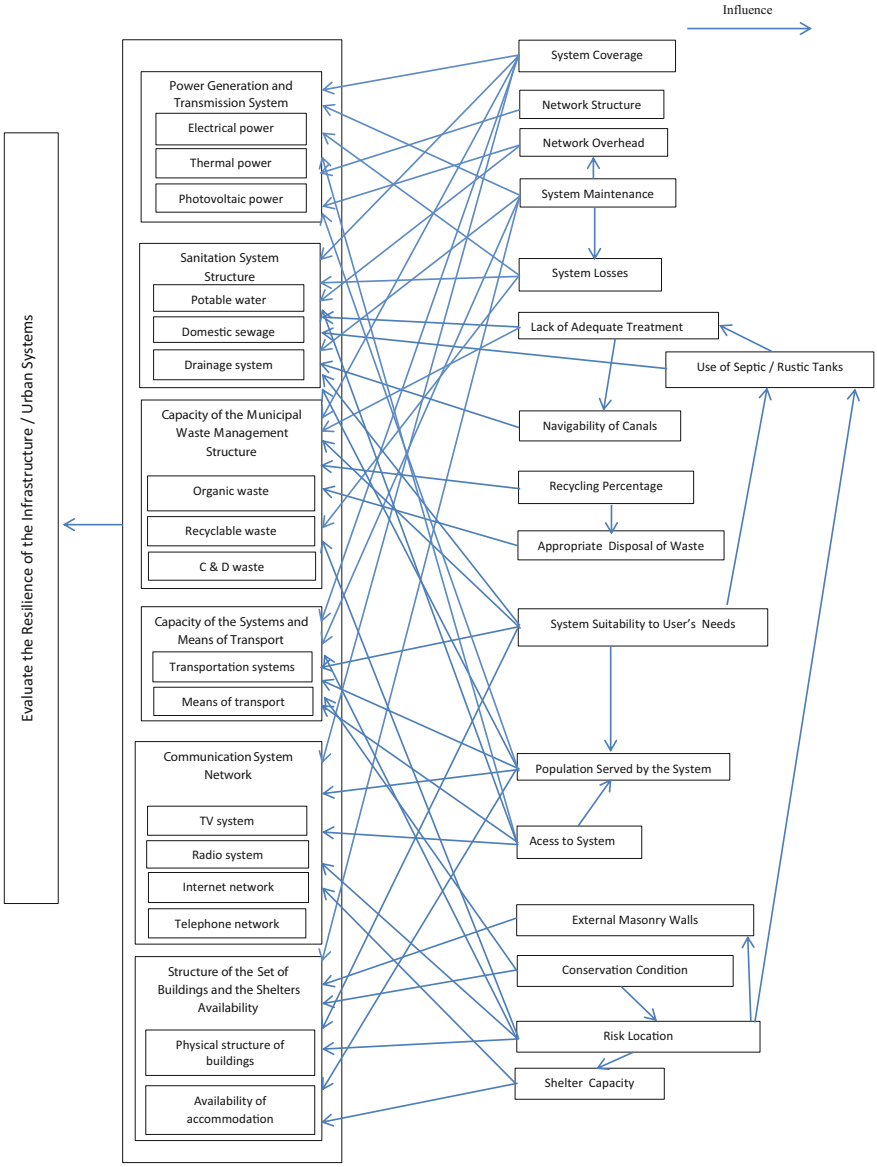

Fig. 3 Means-end objectives network applied to city of Recife

Table 3 Experts interviewed who collaborated with the research

	Profession	Expertise	Occupation
1	Civil engineer	Climate change and urban resilience	Professor and l researcher
2	Civil engineer	Climate change and urban resilience	Professor and researcher
3	Civil engineer	Civil Construction—Urban infrastructure	Professor and researcher
4	Civil engineer	Civil Construction—Urban infrastructure	Professor and researcher
5	Civil engineer	Civil Construction—Urban infrastructure	Professor and researcher
6	Civil engineer	Urban transport and mobility	Professor and researcher
7	Civil engineer	Urban transport and mobility	Professor and researcher
8	Civil engineer	Water and urban sanitation	Private sector employee
9	Civil engineer	Water and urban sanitation	Professor and researcher
10	Civil engineer	Management of private enterprise	Private sector employee
11	Electrical engineer	Renewable energy	Private sector employee
12	Electrical engineer	Urban high-voltage grid	Private sector employee
13	Electrical engineer	Power distribution network	Government employee
14	Architect	Urban planning	Private sector employee
16	Architect	Urban planning	Professor and researcher
17	Architect	Urban waste management	Professor and researcher
18	Meteorologist	Climate change and extreme hydrological events	Government employee
19	Social worker	Civil defense and contingency plan	Government employee
20	Administrator	Urban management	Government employee

3.4 Generating Alternatives—Step 4

The VFT methodology is used to deepen understanding of the problem and to induce creative thinking by stimulating the creation of alternatives as a starting point for understanding decision opportunities. According to Morais et al. (2013),

Table 4 Attributes of the fundamental objectives for the city of Recife

Number	Description
Physical structure for power generation and transmission system	
1.1	**Generation and transmission capacity for electrical power**
1.1.1	Maximize the number of properties connected to power network
1.1.2	Maximize the number of households with electricity in subnormal agglomerates
1.1.3	Maximize energy consumption used in street lighting
1.1.4	Maximize network percentage that is underground
1.1.5	Maximize percentage of isolated electrical conductors
1.1.6	Minimize percentage of defaulted consumers
1.1.7	Minimize percentage of losses = (purchased energy—energy sold)/(purchased energy)
1.1.8	Minimize FEC—equivalent frequency of interruptions in the supply of energy to the consumer
1.1.9	Minimize DEC—equivalent length of interruption of power supply to the consumer
1.2	**Capacity of thermal power generation system that uses gas as fuel**
1.2.1	Maximize percentage of households served by gas network
1.3	**Capacity of photovoltaic power generation**
1.3.1	Maximize percentage of properties using photovoltaic panels
1.3.2	Maximize percentage of public lighting generated by photovoltaics
Sanitation system structure	
2.1	**Distribution and treatment of potable water**
2.1.1	Maximize percentage of population served
2.1.2	Minimize percentage of households served by other sources (contamination threat)
2.1.3	Minimize percentage of transmission losses
2.2	**Distribution and treatment of domestic sewage**
2.2.1	Maximize percentage of households served by network
2.2.2	Minimize percentage of households with open sewage
2.2.3	Maximize On-grid households' percentage
2.2.4	Minimize percentage of households that throw sewage directly into waterways
2.2.5	Maximize percentage of sewage treated
2.2.6	Minimize percentage of households with septic tanks
2.2.7	Minimize percentage of households with rudimentary drains and ditches
2.2.8	Maximize percentage of households with bathroom or toilet
2.3	**Macro drainage system**
2.3.1	Maximize city area percentage met by the macro drainage network
2.3.2	Minimize percentage of population living in flooded areas
2.3.3	Maximize percentage of coated channels
2.3.4	Maximize percentage of channels that are navigable
2.4	**Micro drainage system**
2.4.1	Maximize percentage of the city area covered by the micro drainage network
2.4.2	Minimize percentage of the city area suffering flooding

(continued)

Table 4 (continued)

Number	Description
Municipal waste management structure	
3.1	**Management of organic waste**
3.1.1	Maximize percentage of households with regular garbage collection
3.1.2	Maximize percentage of households with no accumulated garbage in nearby parks
3.2	**Management of recyclable waste**
3.2.1	Maximize percentage of waste that is recycled
3.3	**Management of construction and demolition (C&D) waste**
3.3.1	Maximize percentage of C&D waste that is reused
3.3.2	Maximize percentage of C&D waste that is deposited at appropriate locations
Systems and means of transport	
4.1	**Transportation systems**
4.1.1	Maximize percentage of households with curb/guide
4.1.2	Maximize percentage of roads in households that are wheelchair accessible
4.1.3	Maximize percentage of households on paved streets
4.1.4	Maximize percentage roads with exclusive lanes for buses
4.1.5	Maximize percentage of properties with sidewalks considered legally appropriate
4.1.6	Maximize percentage of roads with bike lanes
4.1.7	Maximize percentage of waterways that are navigable
4.1.8	Minimize growth of the death rate from traffic accidents in the last decade
4.1.9	Maximize percentage distribution of daily average displacement walk
4.1.10	Maximize percentage distribution of daily average of movement by public transport
4.1.11	Minimize percentage distribution of daily average of movement by private transport
4.2	**Transportation facilities**
4.2.1	Minimize percentage of the population that own a car
4.2.2	Minimize percentage of passenger vehicles in urban fleet
4.2.3	Maximize percentage of population transport serviced by bus
4.2.4	Maximize percentage of bus fleet with accessibility for the disabled
4.2.5	Maximize percentage of bus fleet that can be triggered/electronically monitored by firefighters
4.2.6	Maximize percentage of buses in urban fleet
4.2.7	Maximize percentage of population that is served by subway
4.2.8	Maximize percentage of the population that is served by Light Rail Transport (LRT)
4.2.9	Maximize percentage of Bus Rapid Transport (BRT) lines in urban network
4.2.10	Maximize percentage of population that has a motorcycle
4.2.11	Maximize percentage of motorcycles in urban fleet
4.2.12	Maximize percentage of fleet that is a cargo vehicle, pickup truck, or van
4.2.13	Maximize percentage of population that has access to boats
Communication system	
5.1	**TV system**
5.1.1	Maximize percentage of households with a TV

(continued)

Table 4 (continued)

Number	Description
5.2	**Radio system**
5.2.1	Maximize percentage of households with a radio
5.3	**Internet network**
5.3.1	Maximize percentage of households with computers connected to broadband internet
5.3.2	Maximize percentage of population with access to free Wi-Fi internet
5.4	**Telephone network**
5.4.1	Maximize percentage of households with conventional phones
5.4.2	Maximize percentage of households with a mobile device
Buildings and shelters available to house people in case of disaster	
6.1	**Buildings' physical structure**
6.1.2	Minimize percentage of buildings with resistant masonry on 3–4 floors and at potential high risk to collapse
6.1.3	Maximize percentage of buildings with external walls with masonry coating
6.1.4	Minimize percentage of buildings with external walls with uncoated masonry
6.1.5	Minimize percentage of buildings with external walls with other materials
6.1.6	Minimize percentage of inhabitants in subnormal agglomerates
6.1.7	Minimize percentage of buildings located in barrier fall risk sectors
6.1.8	Minimize percentage of risk sectors classified as being at a high and/or very high risk of collapse
6.1.9	Minimize percentage of risk sectors classified as being at a high and/or very high risk of flooding
6.2	**Accommodation availability**
6.2.1	Maximize percentage of residents in risk areas that can be housed in the case of extreme weather
6.2.2	Maximize percentage of resident in risk areas that can be sheltered in the case of extreme weather

the identification of values can lead to creation of additional alternatives, beyond those which already exist, for the problem in analysis.

The causes of the problems were identified through the urban vulnerabilities detected in the field surveys, which were analysed conjointly with the specialists who participated in the study, who identified the main critical points of the problem.

Therefore the importance of structuring this creative process, where the creation of alternatives should be done meticulously, thus preventing that new ideas are anchored in alternatives earlier defined. Thus, some ideas were characterized as an initial step of the creative process, while others were defined as own alternatives of the decision-making process under review (Table 5).

According to Alencar et al. (2011), it is important to underline that in several decision-making contexts the best alternative is not always recognized immediately, even when this alternative is already established. It is important to note that

Table 5 Alternative actions for improving the infrastructure systems and resilience of the city of Recife

• Energy
- Improve the physical structure of the power grid by isolating overhead cables and conductors, as well as underground pipelines
- Create an incentive program for families in substandard clusters to standardize their connections to the power grid, reducing the number of households connected irregularly to the network, which overloads the system
- Develop a preventive maintenance program for the electrical grid
- Invest in the use of other energy sources that can be generated within the city, such as photovoltaic and gas thermal
• Sanitation
- Create a maintenance program for the water and sewage networks
- Check and repair the numerous points of leakage in sewer lines
- Resize and expand the sewer network to adapt to the city's population growth
- Develop a maintenance plan for cleaning urban drainage, as well as streets and galleries
- Make the city's canals more navigable
• Waste
- Establish a cleaning plan for the city, to diminish the amount of trash on public roads and sidewalks
- Prohibit the disposal of household waste in plastic bags on the sidewalks, which contributes to the spread of worms
- Deploy a timeline for cleaning the waterways that run through the city, prohibiting the disposal of industrial waste and domestic sewage in the river
- Encourage the reuse and recycling of demolition and construction waste
• Transport
- Create plan to adapt the transport system to people's needs and to attend to the growing population
- Implement an urgent plan for sidewalk maintenance and restoration
- Create a project to organize parking lots spaces by not permitting vehicles to park anywhere
- Implement signage along street lanes
- Invest in the expansion of the metro network
- Invest in mobility models such as BRT and LRT
• Comunication
- Register cell phones to receive notices of information concerning possible extreme hydrological events
- Implement free Wi-Fi networks for at-risk populations
• Buildings
- Implement an urgent restoration and maintenance plan for the buildings at risk of collapse
- Implement a plan for the restoration of historical buildings
- Investigate irregular buildings, which makes it difficult for civil defence forces to respond in emergency situations
- Review the municipal plan for land use and occupation
- Increase the number of dwellings and shelters to accommodate at-risk populations

achieving this last level (choosing the best alternative among the existing ones) is not the focus of this study.

4 Global Strategies Recommendations

Climate change impacts can increase the vulnerability of urban populations to disasters worldwide. Moreover, the frequency of extreme hydrological phenomena tends to be intensified, such as increases in heavy rain, which can cause two serious risk situations: floods and landslides. The impacts of these phenomena on urban infrastructure systems can render their inhabitants vulnerable to disasters, which converge from three areas: damage to urban settlements, failures in sanitation systems and the electricity supply, and urban mobility.

Climate change effects will increase the occurrence of extreme hydrological events, such as floods. Urban agglomerations which have high population density will, probably, be more vulnerable to its impacts. The lack of urban infrastructure exposes the inhabitants to failures in the urban systems and result in damage to lives and properties. The exploratory survey detected that the most frequent urban vulnerabilities in the city of Recife were related to the electricity network (maintenance of poles and wires), the water distribution and sewage collection networks coverture, the deficient urban drainage systems, the irregular collection of municipal waste which results in garbage being discarded in the waterways and galleries, and the lack of maintenance of roads and sidewalks which delay the flow of vehicular traffic and prevent the mobility of pedestrians. By these important urban infrastructure systems' vulnerabilities verified in the city of Recife, can be concluded that this city is not prepared to face the adverse impacts of possible extreme hydrological events due to the climate changes.

When experts' ideas, opinions, and proposals are being considered, the VFT methodology is fundamental for structuring the problem and enabling the decision-making context to be evaluated better. Moreover, the VFT method ensures concepts can be clarified and identifies hidden objectives, thereby allowing new problem-solving alternatives to be created. As a result, attributes are defined in order to measure the fundamental objectives. The decision opportunities and the aspects that served as input to develop alternatives are also identified.

The methodology can be applied to structure analogous problems in other cities, since it generates alternatives that decrease vulnerability and augment urban resilience to the risk from disasters, thus contributing to urban planning ideas, and to the implementation of mitigation and adaptation strategies to global climate change. furthermore collaborating with the mitigation and adaptation strategies to global climate change. To analyse and structure other problems, the point of view already known should be set aside and all stakeholders must be involved in finding a solution for the problem being considered.

Future studies should consider the application of MCDM (Multi-Criteria Decision Making) approaches as a way of selecting and prioritizing the relevant

alternatives with regard to improving the resilience of the urban infrastructure to extreme hydrological events. The probabilistic context can be considered by applying MAUT (Multi-Attribute Utility Theory), while taking into account the decision-maker's preferences and considering different losses resulting from the consequences of each dimension under study.

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Participatory GIS for Urban Sustainability and Resilience: A Perspective of Social Learning and Ecology of Knowledge

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Abstract The contemporary urbanization model is characterized by unsustainability and environmental injustice as well as social and cognitive exclusion. The search for sustainability and resilience demands better structures of social inclusion and governance to deal with multi-layer determinants and so, it is imperative to promote social participation in decision-making and urban planning. In this chapter we focus on the potentiality of Participatory Geographic Information Systems (PGIS) in terms of fostering social learning and participation, combining spatial, technical and social knowledge and addressing sustainability and resilience issues. A review of PGIS application research findings showed that 25% of PGIS research is applied to urban studies in general, and to natural disasters in cities, such as floods and landslides. According to the review, the PGIS, through the mapping process, that includes social learning and dialogue and aims to apply the ecology of knowledge concept, presents advantages in social engagement when compared to other social participation tools. It has great potentiality to educate and empower citizens, providing better governance and urban scenarios and, therefore, promoting healthier and resilient cities.

Keywords Participatory geographic information systems (PGIS)
Ecology of knowledge · Social learning · Urban resilience · Sustainability

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1 Introduction

According to Hoff (2011), GIZ and ICLEI (2014), urban development is founded on inequality and environmental degradation. While a few have access to an abundance of resources, recklessly exploited without any control, the majority of the population will have to face or is already facing some kind of shortage related to those very same resources. Disorderly urbanization processes typical of developing countries mean that natural resources are used up in an unsustainable manner, aggravating the situation of degradation and undermining the cities' resilience. Currently more than half of the world population lives in cities and 7 out of every 10 of the planet's 9.6 billion inhabitants will be living in cities by 2050 (WHO 2013). Accordingly, efforts to optimize the cities' resources must be redoubled and strategies must be devised to enhance resilience. To that end it is necessary to establish methodologies and tools to achieve efficient planning and governance.

The current urbanization model has generated significant negative social and environmental impacts with direct implications for the health and wellbeing of the citizens. That process of disorderly growth is even more intense in the central areas of cities which are destined for high-income population groups and their associated concentration of resources, while more peripheral areas of the cities, also densely populated, suffer from the lack of basic infrastructure and health problems stemming from that lack and from poor socio-environmental management processes. In that way the cities are becoming less resilient (Razzolini and Gunther 2008; Empinotti and Jacobi 2013). In addition to natural resource deterioration, environmental services provided by the ecosystems (TEEB 2010), like those provided by regional water systems such as domestic water supply, hygiene and sanitation, climate and air humidity regulation and fisheries, also deteriorate.

Very large cities, especially those in developing countries, have been structuring themselves on the basis of a new form of spatializing the same old perverse, profoundly iniquitous social structures, establishing an abyssal cartography showing how social and environmental injustice are linked to glaring vulnerabilities (Santos 2007; Martinez-Allier 2007; Porto and Freitas 2003). Even so, the well-founded analyses of injustice still lack recognition of the fact that there can be no global social justice while an analogous cognitive exclusion is maintained. That statement is based on the recognition that hegemonic academic knowledge, the way it has historically been reproduced, marginalizes local, grassroots knowledge that can be just as valuable and legitimate and is endowed with great potential for application in local contexts (Santos et al. 2009). Indeed it can readily be acknowledged that it is the local practices and wisdom developed and reproduced in vulnerable urban communities that makes their subsistence feasible and establishes responses to their overall situation of precariousness and the glaring absence of the State (Magnani 2002; Nicolini 2012).

Added to that critical scenario of vulnerabilities is the question of climate change and its possible impacts, which tend to exacerbate all the above mentioned urban problems. Those impacts include climate events like prolonged droughts, torrential rains and floods and the landslides associated to these last. They are events that

affect vulnerable locations more seriously and they may set up causal chains that can lead to profound systemic crises (Hales et al. 2004; IPCC 2013). According to Mayntz (2006), such socioenvironmental crises come under the heading of "persistent problems". A persistent problem is typified by the interdependence of the social actors involved, the outstanding need for action on various levels, a lack of feedback that creates gaps in knowledge of the functioning of the urban system, and the very structure of the problems themselves which is in a state of total fragmentation. Such complexity calls for an entirely new governance model.

One way to transform that panorama would be to change the way in which the system is managed, that is to say, improve the governance structures. Governance can be considered to be a process in which new ways are proposed and adopted with a view to establishing an alternative relation between the government level and social demands thereby administering the different interests and existing conflicts, and with the participation of the social actors involved (Jacobi and Fracalanza 2005; Jacobi and Sinisgalli 2012). Taking into account the difficulties inherent to democratization and the extant situation of cognitive exclusion, to achieve any changes in governance there will need to be instruments available that incorporate society's demands such as the use of participatory approaches and social learning processes, which are inductors of collaborative arrangements and processes of co-accountability.

Different arrangements that foster the involvement of social actors, above all, of ordinary people subject to socioenvironmental vulnerability, can contribute towards improving governance structures. It must be taken into account that it is often necessary to overcome the inertia of the subjects in risk situations and make it possible to empower them through a process of getting them to reflect on their own living conditions, rights and possibilities for improvement. Sometimes reflexive processes of empowerment not only lead to a more intense protagonist role in the governance process but also create an interface with the decision-making process, resulting in positive interactions with the public policy agendas (Wallerstein and Duran 2010; Giatti et al. 2014b). The emergence of responses to contemporary problems from society itself, such as non-governmental organizations, Beck (1997) calls "subpolitics". They are legitimate responses and constitute an implicit criticism of the conventional governability paradigm. In that regard, the adoption of instruments capable of enhancing/supporting decision-making processes is an important initiative, particularly in the case of the spatial data management/processing techniques represented by Geographic Information Systems (GIS).

GIS are computer systems for managing geo-referenced, interrelated, spatial data with the functional capabilities of input, manipulation, visualization, analysis, modelling and output and designed to provide support for decision-making and planning (Bonham-Carter 1994). GIS also make it possible to visualize local knowledge. They can manipulate great quantities of data fast and at low cost and make it easier for citizens to fully understand the spatial consequences of proposals and actions. They also facilitate participation at any given moment. Participatory GIS (PGIS) refers to the combination of GIS technology with local knowledge stemming from whatever community is the object of study and it is an instrument that can greatly contribute to empowerment and improving governance (Technical Centre for Agricultural and Rural Development-CTA 2006; Mccall 2004).

The aim of this text is to explore ways in which PGIS can contribute towards expanding citizen participation in governance processes that are marked by social learning and perspectives of sustainability and the expansion of the urban systems' resilience.

2 Background Concepts

2.1 Sustainability and Resilience for a Healthy City

The World Health Organization (WHO) defines the healthy city as one that is continually creating and improving the physical and social environments. Thus a healthy city would be one in which the municipal authorities prioritize the health of their citizens in the wider perspective of quality of life. According to WHO (1995), for a city to become healthy it must make every effort to provide:

A safe, clean environment;

A stable, sustainable environment;

A high degree of social support without exploitation;

A high degree of social participation;

Satisfaction of basic needs;

Access to experiences, resources, contacts, interactions and communication;

Diversified and innovative local economies;

Respect for and pride in the biological and cultural heritages;

Universally accessible health services;

High standards of health patterns.

The WHO Healthy Cities Project is a global movement responsible for engaging governments in promoting health in cities by means of political commitments, institutional changes, capacity building, partnership arrangements and innovative projects. To that end health must become a priority issue on government agendas and be addressed in the light of the inequality and poverty of vulnerable groups in risk situations and the need for participatory governance, and close attention must be paid to health indicators associated to social, environmental and economic factors. Thus the standard of health in a city is very closely bound to its governance model, that is to say, it must be founded on citizen participation, sustainability and resilience. To meet those governance criteria the focus must be primarily on citizen wellbeing, which means that all decisions must be taken bearing in mind the need to achieve equilibrium, based on an inclusive and participatory governance model.

In regard to sustainable use of resources in general, those that society depends on for its survival, especially water, energy and food, they are all interdependent and coupled with the environment. As an example, water and energy are needed to produce food; water, in turn, is needed to produce energy while, to gain access to

water, energy is needed. They are also dependent on the existence of solid infrastructure and their impacts whether positive or negative are also intimately interconnected (Cairns et al. 2017; Bazilian et al. 2011). That interdependence is termed the nexus on water, energy and food with respective trade-offs, and it needs to be profoundly investigated and taken into account in any kind of decision-making that seeks for sustainability, resilience and the reduction social inequalities (Karabulut et al. 2015; Dodds and Bartram 2014; Hoff 2011). According to Cairns et al. 2017, the nexus concept, in its aspect as an innovative and integrating approach, gives prominence to increasing the efficiency and safety of all processes involving resources and, furthermore, to observing the connection between the boundaries of the planet's major resources and human health and urban dynamics. Thus GIZ and ICLEI (2014) state that the urban nexus is an approach focused on: finding solutions for sustainable urban development; and orientating social actors in their efforts to identify possible synergies among sectors, organizations and even technical areas that might enhance performances, optimize resource use and efficiently manage the quality of the services and resources offers. However, for the sustainability perspective of the nexus to be incorporated to the urban governance model, new approaches and tools are needed to make the current, sector-based and compartmentalized, conventional administrative and management structures more transversal. Those new approaches must allow for the social, cognitive and environmental inclusion of society's varied bodies of knowledge, values and beliefs.

Whenever the governance model identifies the resource nexus and takes it into account, urban resilience tends to increase. The key to obtaining resilience lies in the fact that public administration can be called on to take action as soon as any kind of environmental disaster occurs, which means that the administration must be aligned with society's basic needs. As mentioned earlier, the interdependence of resources leads to impacts in series whenever any one of them, such as the availability of potable water, fails. Such impacts undermine urban resilience step by step. Resilience is an essential component that is crucial for achieving sustainable urban development; fostering resilience and enhancing it means adopting new governance models with a focus on equity, social learning and the adaptive capacity. Furthermore, resilience constitutes a bridge to different disciplines and stimulates dialogue among the various social actors for the construction of new policies (Chelleri et al. 2012).

2.2 How Social Learning and the Ecology of Knowledge Can Contribute to Changing Governance

The introduction stated how complex the concept of governance is and how it has gradually changed and evolved in the course of time. In short, governance is the institutionalization of decision-making processes (Levi Faur 2011). Current

governance is typified by the presence of a small group of specialists that holds all the knowledge, does the planning and makes decisions that have repercussions for the entire society (Jacobi et al. 2010). Again according to the Chelleri et al. (2012) urban governance is nothing other than the sum of the various ways in which citizens and public and private institutions plan and manage the city's ordinary affairs. It is an ongoing process whereby conflicting or divergent interests should be accommodated and a cooperative action can be decided on and it can include formal institutions just as well as informal arrangements and the social capital of the citizens. Finally Le Galès and Vitale (2012) consider that "governance is not a linear process, not always rational, incomplete and prone to discontinuities".

In recent years social inclusion practices have been developed that involve learning and dialogue, in keeping with the concepts of Social Learning and the Ecology of Knowledge, and they are aimed at changing the extant forms of governance. Social Learning embraces educational and socioenvironmental practices developed by facilitators together with civil society that are intended to contribute to decision-making processes. Social Learning fosters better collective decisions, builds trust among the social actors and constitutes a shared body of knowledge by means of participatory reflections and practices (Jacobi et al. 2005). The Ecology of Knowledge concept acknowledges the plurality of the knowledge held by various social actors and the need for such knowledge in order to undertake actions in society, among which are basic actions to ensure survival such as obtaining food, work, good health, infrastructure and even organizing social movements. It is important to note that those questions or practices are interdependent and some of them can even be highly innovative (Santos 2007; Stengers 2005).

It must also be borne in mind how, in parallel to the process that established positivist thinking, the hegemony of a certain form of academic thinking established itself which, without entering on a discussion of its merits or demerits, marginalized other forms of knowledge. Academic knowledge is, in fact, just one form of knowledge, not the only one. Based on the recognition of the importance and applicability of other forms of knowledge, such as the traditional forms of knowledge, and admitting the complexity of contemporary challenges, it is worth arguing in favour of promoting a hybridization of knowledge forms, conjugating, for example, traditional knowledge with academic knowledge and thereby leading the way to new learning and new solutions. That hybridization could be achieved by means of participatory interventions made in a more symmetrical perspective with the expectation of promoting an ecology of knowledge (Santos 2007; Giatti et al. 2014a), that is, promoting new forms of socially constituted learning capable of incorporating, among other things, greater robustness and social watchdog control over the relations among science, society and decision-making (Gibbons 1999).

Applying Social Learning and Ecology of Knowledge concepts and practices to address the mentioned persistent problems that Mayntz referred to, and adopting instruments such as participatory approaches could bring about changes in the governance models. It would mean that the society's opinions, knowledge and practices, as well as its demands, would be taken into account in decision-making

processes, thereby raising the level of sustainability of urban development. To that end the practices and concepts would have to be widely applied in society as a whole and not merely applied in isolated situations, as is usually the case. Technical support will be needed to make it feasible to broaden the outreach of practices and change the current panorama. PGIS could well provide support for enhancing that outreach and its potentiality is described in the following section.

3 Role of PGIS in Urban Sustainability: Boosting Social Learning and Ecology of Knowledge to Obtain a New Governance

3.1 Method

This section has been based on an unpublished, bibliographic review of the literature on PGIS and its applications that was undertaken and systematized by the authors. The review examined scientific articles found in two databases: Web of Science and Science Direct. The key phrase used in the search was "participatory geographic information systems". The first screening of articles in the Web of Science portal yielded 282 results for the period covered by the database, which was 1900 to 2016, while the search of the Science Direct database yielded 4672 articles for the period 1972 to 2017. The articles were then filtered by reading all the abstracts and the refinement criterion adopted was that the research or review must make reference to the use of PGIS. After that process there remained 101 Science Direct articles and 118 from Web of Science. The next screening consisted of reading the full text of all the articles. As a result, 47 articles were selected from Web of Science and 43 from Science Direct.

PGIS first application is urban studies, in a range of 20 different topics founded in this review, with 18 articles Second application is natural disasters in an urban context, intrinsically connected to urban resilience, with 11 articles. The cited bibliographic review revealed that the leading application for PGIS studies is in urban studies and that underscores its potentiality for improving governance and resilience of the cities and in consequence, the wellbeing and health of the citizens. Still referring to the review, the following urban planning-related themes were selected for study: tourism, accessibility, transport, parks, cycling pathways, urban green areas, spatial planning, urban aquatic environments, public spaces and studies on minority and marginalized groups. In addition, PGIS is also applied to questions related to natural disasters, more specifically, to floods and landslides. Most part of examined articles refers to research within marginalized groups, however, multi-level approach have been increasing through the last 10 years.

Finally, to build this chapter, some basic concepts that support the healthy and resilient cities building, were presented, such as governance model, ecology of

knowledge and social learning. Then, PGIS application comes to put together these concepts through its practices and tool facilities.

3.2 Discussion

Based on the review it was found that PGIS came into being due to the dissatisfaction of some researchers when they perceived that they were unable to respond to socioenvironmental demands using traditional GIS practices alone. Accordingly, some of them decided to input digital representations of the realities they were researching to databases and in that way obtain a new perception of reality in their pursuit of ways to help people to make their own analyses of the environment they lived in. At the Mapping for Change International Conference on Participatory Spatial Information Management and Communication held in Nairobi, Kenya in 2005, practical experiences with PGIS were widely discussed and the main conclusion was that it could have intense applications in marginalized groups, stimulating innovation, communication and dialogue and, accordingly, generating incentives for positive social changes (Ferreira 2012). That prospect could also be considered a kind of cognitive inclusion, overcoming the abyss separating hegemonic academic knowledge from grassroots forms of knowledge (Santos 2007).

Data gathering methods in participatory GIS practices range from the traditional mapping tools, such as hand drawn sketch maps, to embrace three dimensional models and the interpretation of aerial photographs and satellite images (Mccall 2004). A common step in PGIS, however, is participatory community mapping; a procedure that combines cartographic methods with participatory methods to represent a local community's spatial knowledge. It is firmly founded on the premise that local inhabitants possess a high degree of knowledge about the place where they live and that such knowledge can be expressed in the form of maps which, in turn, are susceptible to being understood by everybody. The maps materialize important elements for legitimizing the participation of social actors by enabling the latter to appropriate technical elements, to include information by their own perceptions, to view their environment in a different light and to think about possible solutions for their own community's problems (Mapping for Rights).

According to Astzmanstorfer et al. (2014), in the current context of metropolis formation PGIS makes it feasible for society to take an active part by denouncing socioenvironmental problems, making suggestions and new proposals or making complaints and even taking part in monitoring and the solutions of the problems; and to do so by means of a web app on cell phones. In addition citizens have an opportunity to connect with and boost social movements and initiatives. Some such initiatives already exist in Brazil like the new app of the city of São Paulo, *Cidade Linda*[1] (Beautiful City), which is intended to facilitate interaction and citizens'

[1](http://cidadelindapp.com.br/).

suggestions and complaints associated to specific themes: water/sewage, the quality of asphalt paving, street lighting, graffiti, signs and safety/security. There is also *Calçada Cilada*[2] (Treacherous Pavement), idealized by the *Corrida Amiga* (Friendly Run) program (a volunteer network that encourages people to move around the city on foot). *Calçada Cilada* endeavours to identify and report problems in São Paulo city's sidewalks. Such inputs mean that decisions can be made in a different way, taking the demands and opinions of society at large into account and gradually transforming the way governance is carried out. Other projects designed to interconnect citizens via internet and geo-referencing are underway all over the world. Some of them are much more than just apps; they are veritable platforms connecting stakeholders. An example is the Maptionnaire[3] software which provides mapping based on a questionnaire and facilitates analysis of the maps produced based on knowledge of the society. That platform is currently being applied in urban planning studies and even in research into city security.

The application of PGIS in disaster studies aims at promoting urban resilience through empowerment and by developing scenarios and action strategies to be unfolded in the event of the occurrence of a disaster. In addition, the products PGIS generates contribute to reducing the risks by inducing better reflection on the part of participants that are exposed to them, apart from the fact that it is an excellent instrument for extracting/obtaining local knowledge about flooding, landslides and all the other kinds of disaster. On the basis of that local knowledge, it is possible to elaborate public policies that are socially equitable and capable of incorporating the point of view that those at risk may have developed based on their insertion in given local contexts (Mccall 2004). Gaillard (2013) states that the unequal distribution of the power of decision is the major factor responsible for the vulnerability of populations when they are confronted with disaster events. In Asian countries it is quite common for the means of protection in episodes of disasters to only be available to the upper classes. The vulnerability of a society is profoundly connected to its governance structure. Lastly, in regard to the urban nexus and its connection with sustainability, there are many papers describing the application of PGIS to agriculture, water resources and renewable energy. Thus the PGIS tool could readily be applied to the study of the urban nexus thereby fostering a much-needed change in the governance model into more sophisticated structures and, consequently, an enhancement of urban resilience by addressing the way environmental disasters and issues like food and energy security are addressed.

According to Mccall (2003), the PGIS has all the features needed to meet the seven criteria of "good" governance (Chelleri et al. 2012), namely: sustainability, equity, efficiency, transparency, responsiveness, the social participation of all the actors present in a community, and security (providing support for citizens' basic rights). The PGIS stimulates social participation by developing maps together with its participants. The empowerment provided by the PGIS stems from the learning

[2](http://corridaamiga.cidadera.com).

[3](https://maptionnaire.com/).

that is generated by the map and dialogue development processes and from the respect afforded and stimulus given to local knowledge. Enquiry is stimulated insofar as the participants in the PGIS process discover their own capacity to understand a socioenvironmental reality and give an opinion about it. Finally, the possession of information and use made of it and the products generated by the PGIS also imply in empowerment and power of decision over the use of the data. All of those elements boost the aforementioned Ecology of Knowledge and the Social Learning processes and they bring about changes in governance and social transformations in the direction of healthier and more sustainable urbanization.

As mentioned earlier, PGIS aims to represent local people's spatial knowledge by applying demand-driven geospatial technologies and spatial representation products (not only map products) that facilitate participatory decision-making processes and support communication and community advocacy. Therefore, it has great power to produce social change, especially through the practice of social learning (Mccall 2015).

The great potential of PGIS is evident in the diversity of situations in which its application has proved to be important and the prospect it offers of collaborating with social learning and improved governance structures by mapping aspects of interest within territories marked by profound inequities, for example, environmental racism (spatial correlation between environmental degradation and the distribution of ethnic groups, or the distribution of socioeconomic groups in cities) and environmental injustice and social inequities (for example, socioeconomic groups in disadvantage, mapping employment, ethnicity, language, gender, caste, age group and access to basic services) (Mccall 2003). Besides, a PGIS advantage is the possibility of using official data and citizen´s data, which provide us a more complete background that allows qualitative and quantitative analysis, being therefore, a solid basis for any planning activity (Kahila and Kytta 2009). PGIS dynamics and the application of its results contribute to empowering marginalized groups and stimulating transparency in decision-making processes and applying them to the development of action plans for improvements in society (Drew 2002; Carver et al. 1999). In that way PGIS has an unquestionable role to play in improving governance, social inclusion, and social learning.

Although GIS is conventionally considered as a technical tool far from common sense, the PGIS shows the possibility to facilitate the organization of society and its interests, stimulating the collective aspect, which it achieves due to its high capacity for visualizing and demonstrating the urgent demands that the maps delineate. It is important to state that the product generated by the PGIS is the raw material for formulating and supporting new forms of public policies, that is to say, a tangible mechanism making it feasible to reinvent policies that incorporate a more reflexive role for society (Beck 1997). Indeed, the prospects opened up by PGIS use seem to be highly consistent with premises underlying the clamour for an Ecology of Knowledge (Santos 2007) given that, by its means, a technological digital platform moves out of the technical/academic domain to corroborate the inclusion of other kinds of knowledge, perceptions, and social representations, thereby materializing

Social Learning processes and identifying the best way forward towards sustainability and urban health and resilience.

4 Conclusions

This chapter explores how PGIS can be applied in urban studies towards sustainability, to improve participation and develop community awareness, which is a step towards empowering the citizens and providing a unique instrument to boost the actions unfolded by Social Learning practices based on Ecology of Knowledge. Furthermore, the bibliographic review of this seminal issue, shows that PGIS can enhance urban resilience by means of the innumerable possibilities it offers for analyses and generating products that can inform and support urban planning and decision–making. It also shows that PGIS as a participatory research and intervention tool has been applied in urban studies and also towards natural disaster research and prevention, which is the core for urban resilience and a healthy cities, considering threats due to climate change consequences. Besides, the potential of quantitative and qualitative data analysis is also an advantage of PGIS application for urban studies, overlapping the mainstream quantitative application of conventional GIS approaches.

It is recommended that PGIS should effectively be used in decision-making carried out together with the society involved and not only in providing informational support for urban planning but also in consultations of society at large, with varying degrees of social participation, thereby contributing to obtaining better governance structures. It should be noted that PGIS is a tangible method for promoting a fair cognitive inclusion and performing the role of engaging more citizens in decision-making processes, making it feasible to produce more critical, hybrid bodies of knowledge and taking society out of its traditional state of marginalization, powerlessness and its non-protagonist role in decision-making processes.

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The Regional Development Councils of Rio Grande do Sul as a Model of Participated Regional Management. Comparative Case Study

João Filipe Torres Soares, Leila Dal Moro, Ulisses Miranda Azeiteiro and Luciana Londero Brandli

Abstract The Regional Development Councils of Rio Grande do Sul (COREDE) in Brazil were instituted by the state law 10.283 of 04/17/1994, and since then they have been the main communication channel between organized segments of the regional society and the State Administration, with citizenship participation promoting regional development. Its greatest achievement in this chapter is the annual coordination of the Popular Consultation, an initiative that calls the Rio Grande do Sul voters to express their choices on the use of a portion of the state investment's budget. Being a model of European inspiration and having this regional area a strong implantation of the Italian culture, this work establishes a parallel between the socio-economic development of a COREDE and an Italian counterpart. This paper focus on regions that share the same economic activity and some cultural identification between their populations. The authors compare data such as the disaggregated HDI, disaggregated IDESE, demographic evolution and GDP per capita, evaluating the 25 years effort of the Coredian movement. The researchers also identify initiatives, programs or projects that contribute to the success of this regional management model for a sustainable regional development and those which actively contribute for the sustainable development goals (SDG) proposed by the United Nations.

Keywords Regional development councils · COREDE · Brazil
Sustainable development · Sustainable development goals

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1 Introduction

With the increasing environmental degradation, the rising of social inequalities and the arisen concern over excessive natural resources consumption (Adams et al. 2015), The Sustainable Development Goals (SDG) appear as a development agenda promoted by the United Nations until 2030, stratified into 17 large areas, subdivided into 169 objectives with measurable goals that will stimulate action for the next 15 years in areas of crucial importance to mankind and to the planet (Buss et al. 2014, p. 2556). Thus, they can become a true element of support to strategies of local, regional and national development.

Working towards regional development based on SDG is a challenge, since it establishes the participation of values and performance of local and professional actors operating in a project environment, without neglecting the importance of the participation of institutions and public policies for sustainable development (Buss et al. 2014, pp. 2756).

To embrace shared responsibility, proposals are needed that integrate all scales, be they local, regional, national or global. Similarly, the implementation of SDGs has emerged, providing a benchmark to address pressing social gaps in the world (Ashley 2012).

Another bottleneck is the understanding that the processes of regional development depend on economic factors, so it is linked to the means of collecting the Union, States and Municipalities, as well as designing and coordinating actions for the construction of a space, evaluating its potentialities and weaknesses, And propose measures to mitigate local disparities (COREDES 2010, p. 11). A territory analysis has multiple effects on local and regional development insights. Thus, new opportunities based on research and development can be presented, indicating a more complete perspective on regional development relating it with the globalization movement (Parrilli et al. 2014).

By analyzing the regions of COREDE Produção (Brazil) and Basilicata (Italy), initiatives can be envisaged for the SDOs, making it possible to work with the different challenges of sustainable development in relation to these regions separated by a long geographic distance, but with economic and cultural activities somehow similar. Neutralizing from the analysis the main cities of both regions (Passo Fundo, Carazinho, Marau, Matera and Potenza) the other cities are small in size with an average of four thousand inhabitants. These are cities with low diversity of uses and activities, with a growing exodus of young people, where the implementation of SDOs may mean a resumption of maintenance for those communities development.

2 Methodology

With the objective of comparing the development and application of the Sustainable Development Goals in the region of COREDE Produção, located in Rio Grande do Sul—Brazil and the region of Basilicata—Italy, and for the best development of the work, it was organized in the following methodological steps.

(A) The selection of areas of study: the selection of regions is due to the fact that they present similarities regarding economic activities and cultural roots. It should also be noted that the choice of an Italian community was linked to the fact that there is an important Italian immigrant ancestry in COREDE Produção, as well as throughout the southern region of Brazil.

(B) The characterization of the regions: the regions were characterized as the number of population, area of territory, population density, cities, productive matrix, illiteracy rate of people aged 15 years or more, life expectancy at birth, infant mortality rate, Annual GDP, GDP per capita, total exports and HDI. Data were obtained through national statistics institutes on both countries about the studied regions. The research was carried out in a short period of time, characterizing itself as a transverse survey.

(C) The identification of sustainable initiatives: the verification of initiatives, programs and projects that can contribute to sustainable regional development and those that actively contribute to the Sustainable Development Goals proposed by the United Nations. COREDE Produção data were obtained together with the Regional Development Council (COREDE Produção) and data from the region of Basilicata were obtained from the National Institute of Statistics (ISTAT) and through a study by Boschma et al. (2013), which is a study on Planning for Development, for the region of Basilicata, in the period between 2014 and 2020.

3 Results and Discussion

The regions under study are called COREDE Produção located in southern Brazil and Basilicata located in southern Italy (Fig. 1).

3.1 Region of COREDE Produção/Rio Grande do Sul/Brazil

The COREDE Produção is currently composed of 21 municipalities, its main city is the city of Passo Fundo, IBGE (2010) counts with a territory of 783.42 km^2 (Fig. 2), an estimated population of 197,798 inhabitants and a density of 235, 92 hab/km^2 GDP is distributed as follows: agriculture 2.41%, industry 16.81%, public administration 11.86% and services 68.92%.

The COREDE Produção region, according to Finamore (2010) presents the transport structure with 90% of the population accessing the main roads at distances of less than 5 km, the highest state index. The transport network is radial concentric, centered on Passo Fundo, The productive structure focuses on the services sector, which represented 65.64% of GDP; Agricultural sector accounts for 13.6% of regional GDP. In that year, the industry held about 20.8% of GDP. The average HDI of the region is 0.746. The highest index is in the City of Casca 0.785.

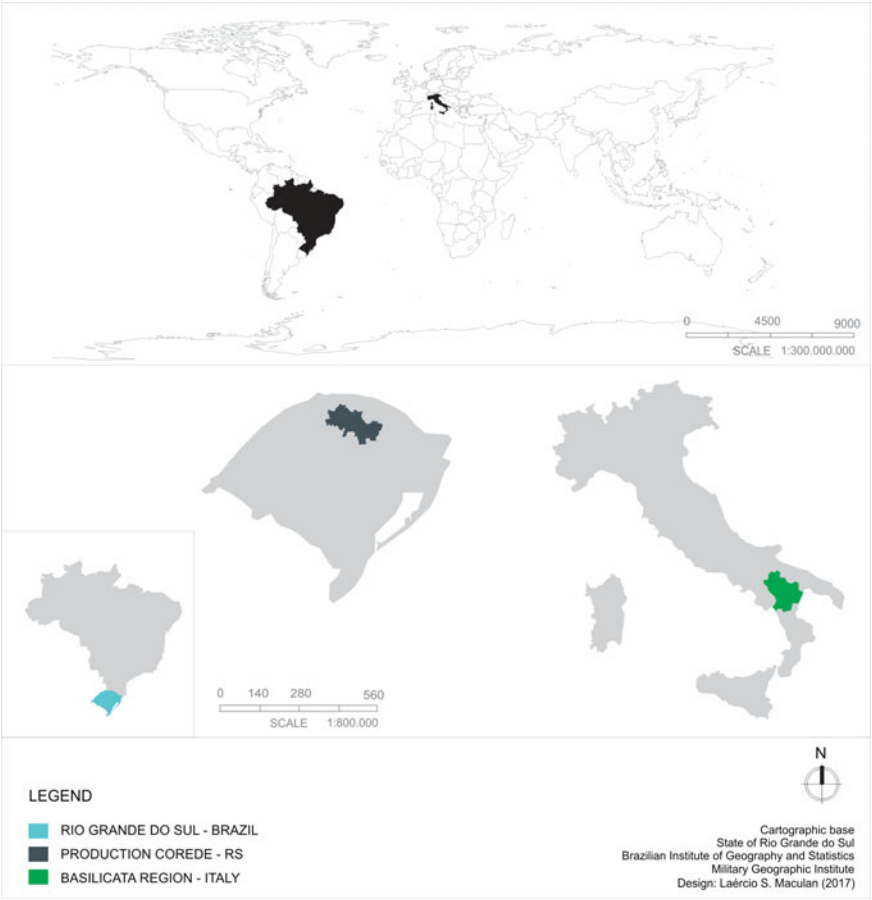

Fig. 1 Physical map of the Regions under study. *Source* Authors, 2017

The population growth in the Region of COREDE Produção had 327,450 inhabitants in 2000 and 344,651 inhabitants in 2007 an increase of 0.73%.

COREDE Produção's infrastructure has federal and state highways, it has a railroad that is used only for cargo transportation and an airport located in Passo Fundo. The main economy of the region is grain production, which puts pressure on increasing it´s cultivated areas and a tendency in the loss of areas with natural vegetation, mainly along the waterways, contributing to the increase of the degradation of water resources, thus making economic and social activities unfeasible, damaging local and regional development (FINAMORE 2008).

According to Finamore (2008), the extension of agricultural and livestock farms varies by up to 5 hectares with 17.1%, from 5 to 10 ha with 15.3%, from 10 to 20 ha with 28.4%, from 20 to 50 ha with 25, 8% and over 50 ha 13.3%. Figure 2 represents the division of COREDE Produção region, as well as the city of Passo Fundo, besides the name of cities, highways, railways and waterways.

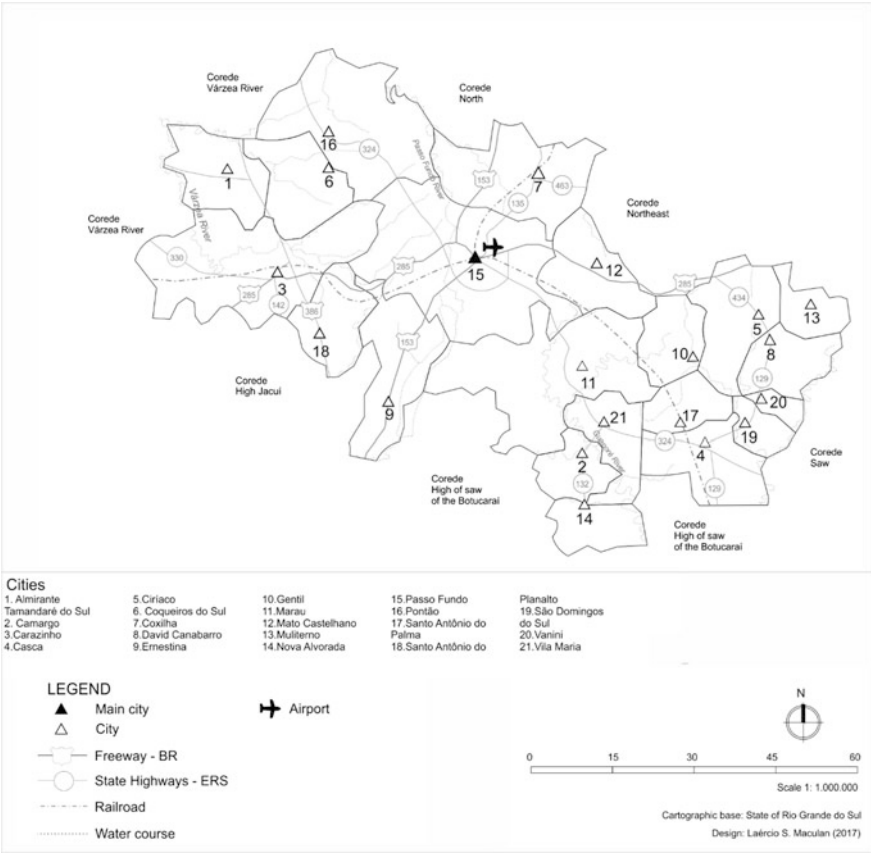

Fig. 2 Physical map of the Region of COREDE Produção—RS, Brazil. *Source* Authors, 2017

3.2 Region of Basilicata/Italy

The region of Basilicata, located in southern Italy, covers an area of 10,073 km^2 (Fig. 3), has a population of 573,694 inhabitants, making it one of the less populated areas in Italy. The region is composed of two provinces, Matera which has an area of 387.4 km^2 and about 200 thousand inhabitants and the province Potenza has an area of 9685.60 km^2 and a population of some 370 thousand inhabitants.

The region of Basilicata has a total of 131 cities, mostly small towns, with an average of 76.90 km^2, population of 4412 inhabitants and population density of 52.65 inhabitants per km^2. The smallest territory is the municipality of Campomagiore covers an area of 12.48 km^2 and the city of San Paolo Albanese has a population of 306 inhabitants. The city of Matera, capital of the province of the same name, has the largest territory of the region with 392.09 km^2, a population of 59,796 inhabitants and a population density of 152.51 hab/km ^{2}. The main city and

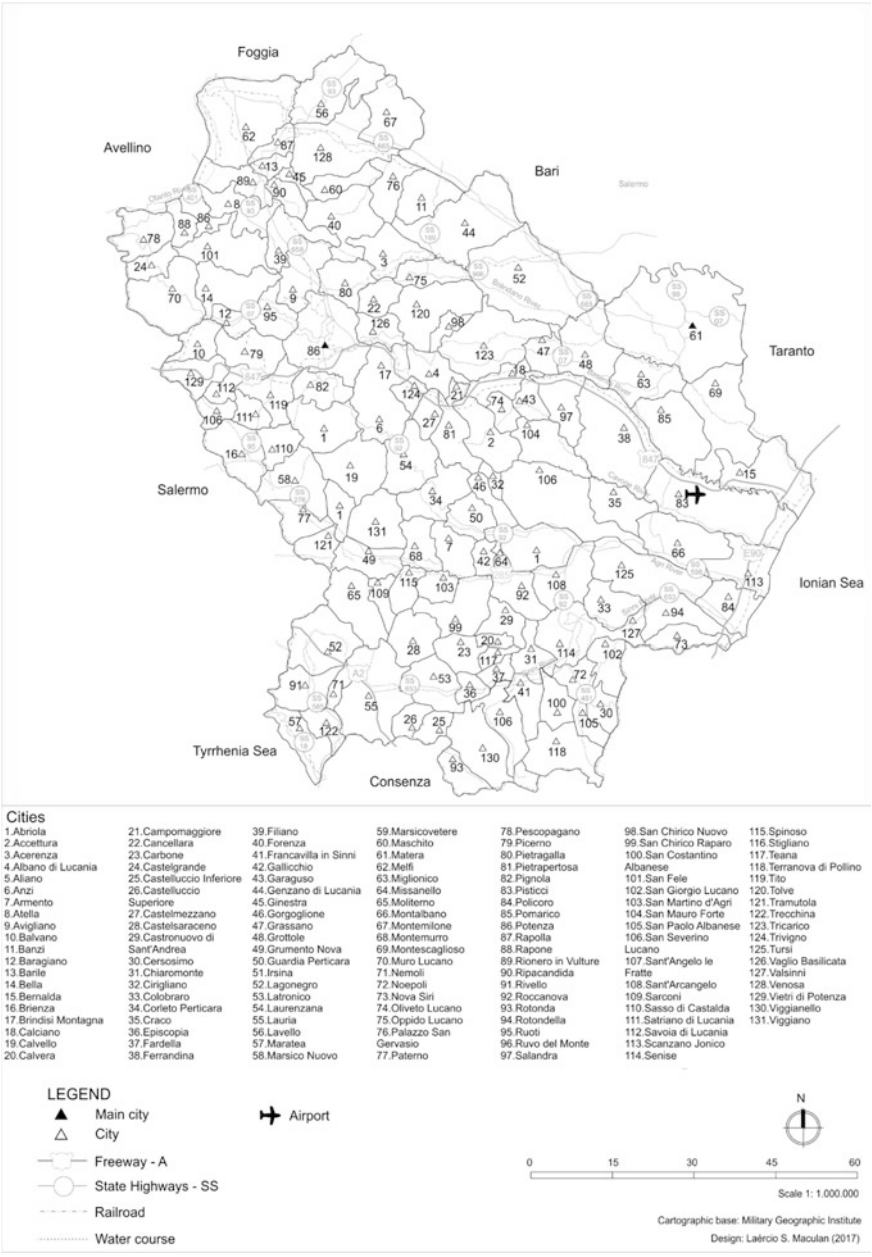

Fig. 3 Physical map of the Region of Basilicata—Italy. *Source* Authors, 2017

capital of the region is Pontenza, which according to Istat (2015) has 66,777 inhabitants, and an area of 175.43 km^2, density of 384.21 hab/km^2.

The southern part of Italy has very different characteristics of the northern part, for example the Human Development Index (HDI), was mated in a work by Salvatore (2002) and the region of Basilicata obtained 0.485 a result 34% lower than the one obtained by the region Of Bologna with the HDI of 0.739, in 2006 it was already 0.837 according to the same author.

The production in the region, according to the Regione di Basilicata (2016), is thus divided in agriculture 48%, industrial sector accounting for 11%, trade and service provision accounting for 35% and other activities with 6%. The city of Melfi has an automobile assembly plant and the Viagiano zone due to the extraction of oil has shown an economic growth. According to the authors, agriculture is undergoing a process of adaptation since there was a 31.9% reduction in the number of properties between 2000 and 2010, the average size of properties went from 7.1 ha to 10.3 hectares and in Basilicata it increase 17% for properties with more than 50 ha.

This region's local culture and traditions have remained unchanged over the centuries and population is very proud of their history and independence. According to Regione di Basilicata (2016) the aging index is 20.5% of the population, for every 100 elderly people there are 65 young people under the age of 14. Another index that worries is the population less than 44 years and <15 years that presented decrease −13.2% in relation to the 2001 census, the Italian average was a decrease of −8.6% that indicates the occurrence of migration to other Regions of the country.

The region does not have port or airport having to use the infrastructure of other regions of Italy. In terms of cargo port, the options for the volume of transport are Trieste (946 km), Genoa (839 km), Livorno (700 km), Gioia Tauro (358 km), Venice (806 km), Ravenna 581 km), and Taranto (158 km). As the airport has landing and takeoff for small aircraft, it is privately owned and is located in the city of Piticci. Figure 3 represents the division of the Basilicata region in cities, with their respective denominations, as well as highways, railways and waterways.

There is unanimity on the fact that the regionalization principles and social participation were implemented in the process of redemocratization in Brazil, started in 1988, as can be concluded from reading Articles 149, 167, 204 and 227 of the State Constitution, approved in the end of the 80s (Buttenbender et al. 2011 and Gonzalez 2013). In this way, through a principle of subsidiarity, the management of public budgets is aimed at solving the problems of the populations and in parallel supervised by them, concluding that it has a greater impact in their lives and in this way promoting the integrated development from the local sphere, passing through the regional one and with impact in the national development ratings. Thus, the institution of the Corediano movement in Rio Grande do Sul, established by the state law no 10283/94, that responds to a national democratic design.

In the Italian case we witness a regionalizing phenomenon with a different motivation. A fragmented territorial past in small kingdoms still retains a high centralization, which over time has been the form found by political and economic

elites to guarantee the status quo, which even the accession to the EEC was unable to resolve (Baldini 2014). It was not until the beginning of the 90s, with the discrediting of the two traditional parties wich had been in alternating in power, that a regionalization of a federative character began to be considered, which has had advances and setbacks that have not yet allowed it's complete implementation, more than twenty years and the subsidiarity principle as described in Eurolex, 2017, is not yet a reality to the Italian population. Here we also have two regionalist typologies of opposite objectives, which affects the analysis but can demonstrate the best model from the point of view of results in the medium and long term.

Table 1 presents the comparative synthesis between socioeconomic indicators of COREDE Produção and the Basilicata Region of Italy. The main differences are the number of municipalities which can be a complicating factor since the region of Basilicata has more representatives of the executive power for the decision making. The volume of GDP 3.4 times higher than COREDE Produção is a difference that

Table 1 Socioeconomic indicators of COREDE Produção-RS, Brazil and the Region of Basilicata, Italy

Socioeconomic indicators	COREDE Produção	Basilicata- Itália
Average population in small cities (excluding major cities)	4.647 hab (11)	3.466 hab (11)
Number of cities	21	131
Total population (number of inhabitants)	358.923 (1)	573.694(9)
Area (km^2)	6.002,7 (2)	10.073 (9)
Population Density (hab/km^2)	57,4	56,95
Illiteracy rate of persons aged 15 years and over	4,02%(3)	23% (9)
Life Expectancy at Birth (years)	71,21 (4)	82,30 (9)
Coefficient of Infant Mortality (per thousand live births)	10,03 (5)	3,17(9)
GDP (billions of dollars)	U$ 3,46 (6)	U$ 11,8 (10)
GDP per capita (dollars per capita)	U$ 10.087 (7)	U$ 20.499(10)
Total Exports (FOB)	U$915.395.979 (8)	U$ 3.074.890.000 (9)

1. FEE – Fundação de economia e estatística (2015)
2. FEE – Fundação de economia e estatística (2015)
3. FEE – Fundação de economia e estatística (2010)
4. FEE – Fundação de economia e estatística (2000)
5. FEE – Fundação de economia e estatística (2015)
6. FEE – Fundação de economia e estatística (2015)
7. Secretaria de Planejamento, Governança e Gestão - RS. (2016)
8. Secretaria de Planejamento, Governança e Gestão - RS. (2016)
9. IStat – Banco de dados estatísticos. Anuario estatistico italiano 2016
10. I.Stat - Banco de dados estatísticos. (2010) Noi Italia. Macroeconomia.
11. Excluding from the analysis the main cities (Passo Fundo, Carazinho, Marau, Matera and Potenza)

Source Authors

can facilitate the implementation of the SDG, but it is a region of Italy that demands a lot of investments in the socio-cultural area to match the average of northern Italy.

From the post-war period the Italian rural territory presented an important phenomenon, the development of urbanization, the birth of small agglomerations around large urban centers. Agriculture gradually has greater specialization and develop various productive processes (industrialization). There is the expansion of energy and technology networks. (Romano and Cozzi 2007)

In a study conducted by Mazziotta (2017) the Basilicata region was evaluated in several aspects, using the Istat database, 36 indicators were used for each of the municipalities for the biennium 2012–2013. An absolute comparison was made over time, each indicator was scaled to the range of 70–130 points with a minimum and a maximum value. The results show that in the central area of the region, there are a large number of municipalities with values above the average for the health, safety and landscape domains, but values below the average for the indices of economic and labor well-being domains.

The highest values of the education domain are in the two capitals of the region and around the larger municipalities. The municipalities with the best environmental performance are in the southern region due to the national parks of Appennino Meridionale and Pollino. As for the quality of services, the region north of Potenza shows good results and in the south of the region, results are below average.

Meanwhile Corede Produção, which was created in October 1994, is organized as a non-profit civil association and is made up of 21 municipalities, totalizing close to 360,000 inhabitants. In this sense a study conducted by regarding security in the region of Corede Production it was observed that the size of the population is a relevant factor in the explanation of the crime incidence.

Tables 2, 3, 4, 5, 6 and 7 intend to systematize the information available for each region, facilitating a comparative analysis articulated by SDG. It presents limitations on the typology of analysis, since one is mostly qualitative, the one supporting COREDE Produção, and that of Basilicata is quantitative and derives from the indicators provided by the Italian Statistical Institute. This difficulty points us to the need for harmonization of the methodologies of work and systematization of data that each national statistical institute must do to provide comparable data that enable public and private decision-makers to choose and implement policies and to exploit regional benchmarking and take advantage of best practices.

On the other hand, the qualitative analysis of COREDE Produção derives from the work of updating the strategic plan for regional development, which included a diagnostic process involving the population, involving more than a thousand citizens at three levels of participation. The methodology was based on the SWOT matrix, validated by the cross-referencing with the statistical data provided by the recently extinct, Statistical and Economy Foundation of the State of Rio Grande do Sul (FEE), associated with the Brazilian Institute of Geography and Statistics (IBGE).

Table 2 Identification of SDG 02 in the region of COREDE Produção—RS—Brazil and in the region of Basilicata—Italy

SDG 2: End hunger, achieve food security, improve nutrition, and promote sustainable agriculture.		
SDG	COREDE Produção	Region of Basilicata
2.1 By 2030, end hunger and ensure access by all people, in pat1icular the poor and people in vulnerable situations, including infants, to safe, nutritious and sufficient food all year round	Although the region is a strong grain producer, much of it is exported "in natura"	Not Available (N/A)
2.2 By 2030, end all forms of malnutrition, including achieving, by 2025, the internationally agreed targets on stunting and wasting in children under 5 years of age, and address the nutritional needs of pregant adolescent girls,pregnant and lactating women and older persons	Decreased food production, but increased grain cultivated area. Between 2010 and 2014 increased by 6.53%	N/A
2.3 By 2030, double the agricultural productivity and incomes of small-scale food producers, in particular women, indigenous peoples, family farmers, pastoralists and fishers, including through secure and equal access to land, other productive resources and inputs, knowledge, financial services, markets and opportunities for value addition and non-farm employment	Today, in the region, the income of rural producers is only related to their own agricultural production	Volume of production per labour unit by classes of farming/pastoral/forestry enterprise size (2013) 26,186 Euros
2.4 By 2030, ensure sustainable food production systems and implement resilient agricultural practices that increase productivity and production, that help maintain ecosystems, that strengthen capacity for adaptation to climate change, extreme weather, drought, flooding and other disasters and that progressively improve land and soil quality	COREDE is moving towards sustainable and resilient system alternatives	Proportion of agricultural area under productive and sustainable agriculture in 2013 is from 8.1%

(continued)

Table 2 (continued)

SDG 2: End hunger, achieve food security, improve nutrition, and promote sustainable agriculture.		
SDG	COREDE Produção	Region of Basilicata
2.5 By 2020, maintain the genetic diversity of seeds, cultivated plants and farmed and domesticated animals and their related wild species, including through soundly managed and diversified seed and plant banks at the national, regional and international levels, and promote access to and fair and equitable sharing of benefits arising from the utilization of genetic resources and associated traditional knowledge, as internationally agreed	COREDE has a culture and strong implantation of genetically modified seeds. The presence of multinationals linked to transgenics is very strong	N/A
2.a Increase investment, including through enhanced international cooperation, in rural infrastructure, agricultural research and extension services, technology development and plant and livestock gene banks in order to enhance agricultural productive capacity in developing countries, in particular least developed countries	There is no Animal Science course at COREDE and agronomy courses are strongly focused on extension monocultures	N/A
2.b Correct and prevent trade restrictions and distortions in world agricultural markets, including through the parallel elimination of all forms of agricultural export subsidies and all export measures with equivalent effect, in accordance with the mandate of the Doha Development Round	N/A	N/A
2.c Adopt measures to ensure the proper functioning of food commodity markets and their derivatives and	N/A	N/A

(continued)

Table 2 (continued)

SDG 2: End hunger, achieve food security, improve nutrition, and promote sustainable agriculture.		
SDG	COREDE Produção	Region of Basilicata
facilitate timely access to market information, including on food reserves, in order to help limit extreme food price volatility		

Source Authors, 2017

Based on what was explained in the course of the work, six SDG was approached for a comparative analysis between the two regions, in this context the SDG analyzed in this phase were the following:

In relation to SDG 02, there is a great difference between the regions, mainly in relation to the amount of cultivated area. Corede Produção has an extensive area for planting, although it has been reducing the area of food production replacing it by the monoculture of soybean, much of which is exported. In Basilicata many of the goals are not yet applied, making the debate impossible.

In the Objective of Sustainable Development that addresses the educational issue, Corede Produção is still in the development phase as far as success is concerned, since there is a high level of withdrawal, just as there is a need for investment in infrastructure and qualified professionals, The question of the high cost of obtaining training. In the Italian region the education is already a little more advanced, in terms of initiation in learning, but in adulthood has much to be improved.

Economic development and decent work for all citizens is an objective that the regions have been developing through actions and incentives in education. The economic development of the COREDE Produção region is largely due to the effectiveness of soy monoculture, which brings opportunities and growth for the region. In the same way that the region of Basilicata that addresses employment data associated with education, that is, the economic growth of a region is relatively correlated to investment in infrastructure and education, generating skilled labour.

The implementation of this SDG reveals the importance of the European integration area. In fact, in Italy, as in all European Union (EU) member states, there are EU directives on these matters that have to be transposed into national regulations, and there may be only time differences in their implementation. It would be important in the case of COREDE Produção to make a survey of these directives and study their transposition into the regional reality. On the other hand, it is important to establish the necessary conditions for a regional integration of public policies in the scope of this Objective, in fact there are initiatives led by the academic environment that run counter to the incapacity of the public bodies or are embarrassed between confused legal processes becoming inconclusive.

Table 3 Identification of SDG 04 in the region of COREDE Produção—RS—Brazil and in the region of Basilicata—Italy

SDG 4: Ensure inclusive and equitable quality education and promote lifelong learning opportunities for all		
SDG	COREDE Produção	Region of Basilicata
4.1 By 2030, ensure that all girls and boys complete free, equitable and quality primary and secondary education leading to relevant and effective learning outcomes	The dropout rate in high school is high, as is the rate of failure	Not Available (NA)
4.2 By 2030, ensure that all girls and boys have access to quality early childhood development, care and preprimary education so that they are ready for primary education	COREDE has 100% coverage in primary education	Participation rate in organized learning (one year before the official primary entry age), by sex in 2015 is from 100%
4.3 By 2030, ensure equal access for all women and men to affordable and quality technical, vocational and teltiary education, including university	Private higher education is still expensive and with the change of criteria for granting financial incentives will tend to diffuse equity in access to this level of qualification, on the other hand vocational education are mainly paper and pencil courses.	Participation rate of youth and adults in formal and non-formal education and training in the previous 12 months, by sex in 2006 is from 19.9%.
4.4 By 2030, substantially increase the number of youth and adults who have relevant skills, including technical and vocational skills, for employment, decent jobs and entrepreneurship	In this chapter COREDE is long overdue	N/A
4.5 By 2030, eliminate gender disparities in education and ensure equal access to all levels of education and vocational training for the vulnerable, including persons with disabilities, indigenous peoples and children in vulnerable situations	Do not have information	N/A
4.6 By 2030, ensure that all youth and a substantial proportion of adults, both men and women, achieve literacy and numeracy	The illiteracy rate is high, due to two factors: increasing longevity and changing classification criteria	N/A
4.7 By 2030, ensure that all learners acquire the	There are environmental awareness initiatives, but as	N/A

(continued)

Table 3 (continued)

SDG 4: Ensure inclusive and equitable quality education and promote lifelong learning opportunities for all		
SDG	COREDE Produção	Region of Basilicata
knowledge and skills needed to promote sustainable development, including, among others, through education for sustainable development and sustainable lifestyles, human rights, gender equality, promotion of a culture of peace and non-violence, global citizenship and appreciation of cultural diversity and of culture's contribution to sustainable development	the school is not concerned with training professionals is focus on generic knowledge and not oriented to the economic activities predominant in COREDE	
4.a Build and upgrade education facilities that are child, disability and gender sensitive and provide safe, nonviolent, inclusive and effective learning environments for all	The public education network needs adaptation, restoration and some cases, substitution	N/A
4.b By 2020, substantially expand globally the number of scholarships available to developing countries, in particular least developed countries, small island developing States and African countries, for enrolment in higher education, including vocational training and information and communications teclmology, technical, engineering and scientific programmes, in developed countries and other developing countries	N/A	N/A
4.c By 2030, substantially increase the supply of qualified teachers, including through international cooperation for teacher training in developing countries, especially least developed countries and small island developing States	Ongoing teacher education is a demand. This is done superficially for the teachers of the state network but the municipal teaching network is totally out of the system	N/A

Source Authors, 2017

Table 4 Identification of SDG 08 in the region of COREDE Produção—RS—Brazil and in the region of Basilicata—Italy

SDG 8: Promote sustained, inclusive and sustainable economic growth, full, productive employment and decent work for all		
SDG	COREDE Produção	Region of Basilicata
8.1 Sustain per capita economic growth in accordance with national circumstances and, in particular, at least 7 per cent gross domestic product growth per annum in the least developed countries	N/A	Annual growth rate of real GDP per capita in 2016 is from the 4.5%
8.2 Achieve higher levels of economic productivity through diversification, technological upgrading and innovation, including through a focus on high-value added and labour-intensive sectors	COREDE witnesses the reverse movement, with the introduction of increasingly mechanized agricultural production and de-industrialization	Annual growth rate of real GDP per employed person in 2015 is from the 1.4%
8.3 Promote development-oriented policies that support productive activities, decent job creation, entrepreneurship, creativity and innovation, and encourage the formalization and growth of micro-, small- and medium-sized enterprises, including through access to financial services	N/A	
8.4 Improve progressively. through 2030, global resource efficiency in consumption and production and endeavour to decouple economic growth from environmental degradation, in accordance with the 10-year framework of programmes on sustainable consumption and production, with developed countries taking the lead	The extensive production of monocultures in COREDE contributes to environmental degradation and does not promote the equitable growth of communities	N/A
8.5 By 2030, achieve full and productive employment and decent work for all women and men, including for young people and persons with disabilities, and equal pay for work of equal value	N/A	Unemployment rate, by sex, age and persons with disabilities 2015 is from the 13.7%

(continued)

Table 4 (continued)

SDG 8: Promote sustained, inclusive and sustainable economic growth, full, productive employment and decent work for all		
SDG	COREDE Produção	Region of Basilicata
8.6 By 2020, substantially reduce the proportion of youth not in employment, education or training	COREDE has 100% coverage in primary education	Proportion of youth (aged 15–24 years) not in education, employment or training in 2015 is from the 28.7%
8.7 Take immediate and effective measures to eradicate forced labour, end modern slavery and human trafficking and secure the prohibition and elimination of the worst forms of child labour, including recruitment and use of child soldiers, and by 2025 end child labour in all its forms	N/A	N/A
8.8 Protect labour rights and promote safe and secure working environments for all workers, including migrant workers, in particular women migrants, and those in precarious employment	Labour laws and their enforcement guarantee the protection of workers' rights.	Frequency rates of fatal and non-fatal occupational injuries, by sex and migrant status in 2014 is from the 25.7%
8.9 By 2030. devise and implement policies to promote sustainable tourism that creates jobs and promotes local culture' and products	There are several tourist opportunities to explore in the region	N/A
8.10 Strengthen the capacity of domestic financial institutions to encourage and expand access to banking, insurance and financial services for all	In COREDE there are cooperative banking infrastructures in addition to the traditional ones	N/A
8.a Increase Aid for Trade Suppolt for developing countries, in particular least developed countries, including through the Enhanced Integrated Framework for Trade-Related Technical Assistance to Least Developed Countries	N/A	N/A
8.b By 2020, develop and operationalize a global strategy for youth employment and implement	Youth employment is a problem in that it recognizes the inability of the school to set the best and provide the	N/A

(continued)

Table 4 (continued)

SDG 8: Promote sustained, inclusive and sustainable economic growth, full, productive employment and decent work for all		
SDG	COREDE Produção	Region of Basilicata
the Global Jobs Pact of the International Labour Organization	majority of technical skills that allow immediate entry into the local labour market	

In the region there are few municipalities that have a waste management plan, for example, the recycling industry is incipient and the selective collection is only factual, not allowing the material to be actually recycled because most of it is contaminated, so the initiatives of recycling or reuse are almost exclusively in the hands of private initiatives, punctual and disconnected. Otherwise in the region of Basilicata it is possible to identify an effort in this chapter, and above all to find it measured.

In the chapter on the production of food there is no consumption planning for supplying and the region is highly deficient, although all its potential is devoted to the production of grain, which is mainly exported "in natura", not bringing to the region any added value or financial gain, neither technological nor human, making of it an excellent terrain for the penetration of multinationals that essentially seek profit. It is losing fertile ground at an average of 5% a year (Carrão 2015), which implies the excessive consumption of fertilizers and agro toxics to maintain high production ratios. In contrast, the Italian region has a diversified production of consumer food products and managed to diversify its economic activities in order to diversify the pillars of its economy by increasing its resilience and responsiveness in crisis scenarios.

Climate change is in the citizens' consciousness and has been a constant theme of the diagnostic meetings mentioned in COREDE Produção, which proves its reflection in the daily life of the population and in their activities, especially agricultural and livestock. There is a Climate Observatory in the region, headquartered at the UPF and serves as a source of forecast climate information for some productive sectors, but curiously not in the region where it is based. On the other hand there are other entities that maintain records, but that are not always coincident or comparable because of varying methodologies of data collection.

Table 8 shows the projects carried out in the regions related to the SDG axes, in this sense it is possible to analyze that both regions are developing actions for sustainable development.

Table 8 expands some projects and actions developed by the regions and some deficiencies that can be improved and in favoured by investments; And for regional issues such as culture and political priorities. It is extended to the axes related to agriculture, economic issues, logistics, environment, health, education and security. Above all, both regions deserve attention and highlight actions and commitment that value activities for sustainable development that reach cultural issues and motivate society to commit to public policies and activities that value the three pillars of sustainability.

Table 5 Identification of SDG 11 in the region of COREDE Produção—RS—Brazil and in the region of Basilicata—Italy

SDG 11: Making Cities and Human Settlements Inclusive, Safe, Resilient and Sustainable		
SDG	COREDE Produção	Region of Basilicata
11.1 By 2030, ensure access for all to adequate, safe and affordable housing and basic services and upgrade slums	There is no public policy for the eradication of tents although there is a national policy for the eradication of poverty	N/A
11.2 By 2030, provide access to safe, affordable, accessible and sustainable transpOlt systems for all, improving road safety, notably by expanding public transpOIi, with special attention to the needs of those in vulnerable situations, women, children, persons with disabilities and older persons	Only Passo Fundo (PF) is in the process of preparing the diagnosis for the sector for renegotiation of public transport concession contracts	Proportion of population that has convenient access to public transport, by sex, age and persons with disabilities in 2015 is from the 33.1%
11.3 By 2030, enhance inclusive and sustainable urbanization and capacity for pmticipatory, integrated and sustainable human settlement planning and management in all countries	This is a concern only verified in Passo Fundo	N/A
11.4 Strengthen efforts to protect and safegum'd the world's cultural and natural heritage	Lack of enforcement to ensure compliance with legislation	N/A
11.5 By 2030, significantly reduce the number of deaths and the number of people affected and substantially decrease the direct economic losses relative to global gross domestic product caused by disasters, including water-related disasters, with a focus on protecting the poor and people in vulnerable situations	N/A	N/A
11.6 By 2030, reduce the adverse per capita environmental impact of cities, including by paying special attention to air quality and municipal and other waste management	This concern is only verified in the regional centres of COREDE	Proportion of urban solid waste regularly collected and with adequate final discharge out of total urban solid waste generated, by cities in 2014 is from the 52.0%

(continued)

Table 5 (continued)

SDG 11: Making Cities and Human Settlements Inclusive, Safe, Resilient and Sustainable		
SDG	COREDE Produção	Region of Basilicata
11.7 By 2030, provide universal access to safe, inclusive and accessible, green and public spaces, in particular for women and children, older persons and persons with disabilities	Insufficient PDMs that do not guarantee accessibility and mobility and equity.	Average share of the built-up area of cities that is open space for public use for all, by sex, age and persons with disabilities in 2014 is from the 5.6%
11.a Support positive economic, social and environmental links between urban, peri-urban and rural areas by strengthening national and regional development planning	There are no permanent policies	N/A
11.b By 2020, substantially increase the number of cities and human settlements adopting and implementing integrated policies and plans towards inclusion, resource efficiency, mitigation and adaptation to climate change, resilience to disasters, and develop and implement, in line with the Selldai Framework for Disaster Risk Reduction 2015–2030, holistic disaster risk management at all levels	N/A	N/A
11.c Support least developed countries, including through financial and technical assistance, in building sustainable and resilient buildings utilizing local materials	N/A	N/A

Although separated by more than 15,000 air miles, the two regions with no prior technical/strategic contact for sustained development, but only with a common matrix primer derived from the SDG, envision a "transformation for sustainability" (Patterson et al. 2016) draws on very close guidelines which shows the relevance and need for global alignments that translate into high local and regional impact measures. It is also important to emphasize the importance of the fourth pillar for sustained, institutional development, which is fundamental in communities with medium HDI that characterize them in the development process, because only by

Table 6 Identification of SDG 12 in the region of COREDE Produção—RS—Brazil and in the region of Basilicata—Italy

SDG 12: Ensure sustainable consumption and production patterns		
SDG	COREDE Produção	Region ofBasilicata
12.1 Implement the 10-year framework of programmes on sustainable consumption and production, all countries taking action, with developed countries taking the lead, taking into account the development and capabilities of developing countries	N/A	N/A
12.2 By 2030, achieve the sustainable management and efficient use of natural resources	N/A	N/A
12.3 By 2030, halve per capita global food waste at the retail and consumer levels and reduce food losses along production and supply chains, including post-harvest losses	N/A	N/A
12.4 By 2020, achieve the environmentally sound management of chemicals and all wastes throughout their life cycle, in accordance with agreed international frameworks, and significantly reduce their release to air, water and soil in order to minimize their adverse impacts on human health and the environment	There is work to be done in this field, especially in what is associated with soybean monoculture	N/A
12.5 By 2030, substantially reduce waste generation through prevention, reduction, recycling and reuse	It is urgent to place equipment for this purpose at COREDE and at its borders.	National recycling rate, tons of material recycled in 2014 is from the 27.3%
12.6 Encourage companies, especially large and transnational companies, to adopt sustainable practices and to integrate sustainability information into their reporting cycle	N/A	N/A
12.7 Promote public procurement practices that are sustainable, in accordance with national policies and priorities	The offer is restricted and there is no such concern in the purchase system of public entities	N/A

(continued)

Table 6 (continued)

SDG 12: Ensure sustainable consumption and production patterns		
SDG	COREDE Produção	Region ofBasilicata
12.8 By 2030, ensure that people everywhere have the relevant information and awareness for sustainable development and lifestyles in harmony with nature	There has to be a work of formation and information at different levels to internalize these values in the daily life of the populations	N/A
12.a Support developing countries to strengthen their scientific and technological capacity to move towards more sustainable patterns of consumption and production	Brazil has this kind of support	N/A
12.b Develop and implement tools to monitor sustainable development impacts for sustainable tourism that creates jobs and promotes local culture and products	There are no such tools in COREDE	N/A
12.c Rationalize inefficient fossil-fuel subsidies that encourage wasteful consumption by removing market distortions, in accordance with national circumstances, including by restructuring taxation and phasing out those harmful subsidies, where they exist, to reflect their environmental impacts, taking fully into account the specific needs and conditions of developing countries and minimizing the possible adverse impacts on their development in a manner that protects the poor and the affected communities	N/A	N/A

Source Authors, 2017

strengthening institutions and creating partnership networks It will be more effective to mature the concepts of governance that will allow the qualification and valorisation of the intervention by citizenship in the centres of regional development. In this context we highlight the remarkable recovery of Basilicata in just 4 years, between 2002 and 2006.

Table 7 Identification of SDG 13 in the region of COREDE Produção—RS—Brazil and in the region of Basilicata—Italy

SDG 13: Making urgent action to combat climate change and its impacts		
SDG	COREDE Produção	Region of Basilicata
13. I Strengthen resilience and adaptive capacity to climate-related hazards and natural disasters in al1 countries	N/A	Number of countries with national and local disaster risk reduction strategies in 2010 is from the 9.46%
13.2 Integrate climate change measures into national policies, strategies and planning	There are no such concerns in the economic activities developed in COREDE	N/A
13.3 Improve education, awareness-raising and human and institutional capacity on climate change mitigation, adaptation, impact reduction and early warning	COREDE has in the main urban pole the implementation of Agenda XXI, which should be extended to all the COREDE	N/A
13.a Implement the commitment undertaken by developed-country parties to the United Nations Framework Convention on Climate Change to a goal of mobilizing jointly $100 billion annually by 2020 from all sources to address the needs of developing countries in the context of meaningful mitigation actions and transparency on implementation and fully operationalize the Green Climate Fund through its capitalization as soon as possible	N/A	N/A
13.b Promote mechanisms for raising capacity for effective climate change-related planning and management in least developed countries and small island developing States, including focusing on women, youth and local and marginalized communities	N/A	N/A

Source Authors, 2017

Table 8 Projects related to the sustainable development objectives

CORE DE Development Guidelines	Projects Corede	Basilicata Development Guidelines	*SDG (ONU)
1. Foster productive diversification with a focus on family farming, of organic origin	7.1.1 - Production Diversification on smallholdings based on food prodution for self-consumption/subsistence culture; 7.1.2 - Expansion of the family agro-industry from the surplus of agricultural production; 7.1.3 - Rural management; 7.1.4 - New field; 7.1.5 - Strengthening EMATER's role in the rural product; 7.1.6 - Integral work in rural development; 7.1.7 - Breeding herds; 7.1.8 Small integrated slaughter units; 7.1.11 Table of minimum producer prices; 7.1.12 Pasture qualification; 7.1.13 Support for the diversification on food production; 7.1.14 Expansion of Rural Tourism; 7.1.15 Finance actions on animal health; 75.1.160 Acquisition of agricultural inputs to recover soil fertility to improve fertility, increase production and pasture, etc..; 7.3.10 Maintenance of young people in the countryside in order to reduce rural exodus; 7.8.1 Introduction of canola as winter crop	Proposal from the European Commission (EC) for a change in the Community Agricultural Policy (CAP) for the period 2014-2020, ecological farming areas will be created. Develop farms for individual educational purposes, such as those that focus on social and therapeutic skills; Biodiversity, rural landscape, leisure and tourism, water quality, soil protection, to be implemented need public action through financial compensation. Mechanization can be adopted in rural areas to improve overall value and leverage local economic development. There are two major Metapontin and Vulture districts that develop traditional agriculture. The following political measures were proposed to the agrifood districts: - Improve the relationship between local producers and buyers through a regional logistics platform. - Enable the implementation of a system of import and export trade of regional production. The marketing strategy for the certification of food products, and consequent improvements throughout the production chain in addition to adding value to the products and the place	2 7 11 15
2. Installation of regional agroindustrial cooperative			
3. Price and market fixing for the small producer			
4. Fiscal/financial incentives for the introduction of clean technologies and also for the energy use of by-products in rural activity			
5. Technical and professional training of rural producers			

(continued)

Table 8 (continued)

COREDE Development Guidelines	Projects Corede	Basilicata Development Guidelines	*SDG (ONU)
1. Systematize and standardize the application of legislation	7.2.1 Alignment of Municipal Management Plans (PDMs); 7.2.2 Installation of the Investor's Office at regional level; 7.2.3 Public Management Excellence Program; 7.2.8 Creation of a Regional Development Agenda in Corede; 7.2.12 Standardization of the regional management structure; 7.2.13 Municipal Strategic Development Plans; 7.9.1 Multi-purpose registration	The national and regional governments of Basilicata have a number of potential instruments available to make an impact at the regional level. The appropriate complementary measures enabling them to achieve three objectives: to encourage investment, responsible development, stability and security. At the city level it is important to promote sustainable mobility through an incentive structure to reconvert the fleet of local media and a series of control and monitoring measures to encourage the use of public transport (in this regard it is even more important to have a Framework plus general current supply and difficulties)	17
2. Technical training of the municipal public manager at the executive and legislative levels			
3. Encouraging the construction of municipal plans for sustainable development articulated regionally			
4. Creation of a regional development agency			
5. Desburocratization			
1. To train those responsible for municipal finances on mechanisms to combat the evasion of taxes/taxes and alternative forms of generating their own income	7.2.6 Law enforcement as a deterrent; 7.2.9 Redistribution of ICMS; 7.2.11 Training for technical inspection staff	Propose exchanges between several companies of the same district, to instigate innovation and regional diversification. The establishment of new industries contribute to the renewal and development of the region. The type of policy measure to implement similar diversification of activity in a region. The region of Basilicata should develop a policy to broaden and renew the industrial structure of the region and bring together new and similar activities	17
2. Redistribution of taxes in order to promote local and regional development			
1. Diversify industrial activities with a focus on health and education	7.1.9 Encouraging the installation of a soybean processing unit; 7.1.10 Regional Technology		8 9

(continued)

Table 8 (continued)

COREDE Development Guidelines	Projects Corede	Basilicata Development Guidelines	*SDG (ONU)
2. To invest in the recycler industry and support infrastructure for the supply of raw materials	Center; 7.2.4 Identification of the tourist potential of the region; 7.2.5 Financial markets at the service of the producer	Address the lack of skills focused on innovation in small businesses, through technical support, legal and financial advice. Provide local small businesses with an affordable, reliable and high quality internet access. Develop the improvement of the local workforce. Develop and enhance the relationship between public and private companies by instigating collaboration. Promote actions between companies. To promote the interaction between companies and the University for the promotion of hatchery projects or by-products. The promotion and implementation of public policies such as: "Basilicata innovation and development" Avoid the flight of young people with a high level of schooling, through the implementation of a database to ensure employability in the region. Encourage the return migration of young people who are going to specialize in other regions or abroad	
3. Research and Development (R & D) in new areas of knowledge and materials			
4. Bets on transport infrastructures to reduce costs and boost export channels			
1.Expand the activity of the Observatory of the Climate, dissipating forecast meteorological information to support the	7.5.1 Completion of the basic sanitation network; 7.5.2 Sewage Treatment Stations; 7.5.3 Micro energy generation in rural	Natural resources systems are precious points in Basilicata, for the generation of fossil fuels, water and firewood, climate regime, fresh air,	6 12 13

(continued)

Table 8 (continued)

COREDE Development Guidelines	Projects Corede	Basilicata Development Guidelines	*SDG (ONU)
management of the agricultural production process	property; 7.5.4 Eco centers; 7.5.5 Eco Points; 7.5.6 Recovery of riparian forests; 7.5.7 Climate observatory; 7.5.8 Geological and geomorphic survey of the region; 7.5.9 Use of rainwater systems; 7.5.10 Expansion of water collection points for analysis and transparency in the results disclosure	options of visitation (free time, landscape and animal observation). Politicians should envisage actions that provide various tourism services. Organize actions between mountain and sea area. Check the demand of tourism and the population regarding free time to enjoy the tourist service. Evaluate the flow of visitors, especially during the day, as the region has mountains and beaches that are visited during the day. To design the development of tourism guided by the necessary demand. The development Of a recognized regional mark. The guarantee of a high level of quality for the visitors and for all those involved in the activities. Regulation and labeling of controlled origin is a possibility for valuing cultural specificities	
2. Articulate scientific knowledge about micro-generation with the rural world and its energy needs			
3. Protection and preservation of water resources by means of classification as a resource of strategic importance for the State of RS			
1. Improve the conditions of traffic of the highways	7.4.1 Extension and improvement of LauroKortz Airport; 7.4.3 Cycle routes as an alternative in urban mobility; 7.4.4 Symbiotic industrial condominium; 7.4.5 Construction of an overpass on RS-135 in the BR-285 clover; 7.4.6 Creation and revitalization of rest areas along inter-municipal roads; 7.4.7 Doubling of BR-285 between Carazinho and Passo Fundo; 7.4.8 Doubling of BR-386 between Soledade	The physical infrastructure of Basilicata is underdeveloped and underutilized due to its rather fragmented urbanization model. Have high speed rail services. Improve the external connection with Puglia and Campania. Priorities for financing major projects are in railways, highways and the airport. In	12 17
2. To diversify the modes of transportation of people and goods			
3. Support the introduction of renewable energies in means of transport			
4. Expansion of the coverage rate of the mobile communication and data network			

(continued)

Table 8 (continued)

COREDE Development Guidelines	Projects Corede	Basilicata Development Guidelines	*SDG (ONU)
5. Dry port installation in the regional reference municipality	and FredericoWestphalen; 7.4.9 Doubling of the RS-135 between Passo Fundo and Erechim; 7.4.10 Duplication of RS-324 between Passo Fundo and Barca; 7.4.11 Maintenance of RST-153 between Passo Fundo and Uncle Hugo; 7.4.12 Technical and environmental feasibility study for the installation of an international cargo airport; 7.4.13 Technical and environmental feasibility study for the installation of a connecting rail link between Carazinho and the North-South line; 7.4.14 Internet for all; 7.4.15 Asphalt paving ERS 330 between the São Bento District (CZO)/Chapada; 7.4.16 Plan for the recovery and expansion of the northern rail system; 7.4.17 Asphaltic recovery VRS 801 between the junction with the BR-386 and Chapada; 7.4.18 Railways; 7.4.19 International cargo airport	particular the improvement in the connection between Potenza, Melfi and Foggia. Improve communication and information infrastructure. Implement an integrated, systematic and updated information system on demand and service offer. So far, it seems that transport policy has been done on the basis of projects. The Basilicata region may decide to integrate this information system with Periodic studies, which collect information on the essential needs for the density of services, and which is stratified by students, workers and the elderly	
1. Create permanent training mechanisms for political decision-makers and other actors involved in local and regional management; 2. Create vacancies in vocational technical schools so that the young people can continue in the field or in their city of origin 3. Continuing education of teachers in the public education network	7.3.1 Leading the Future Program; 7.3.2 Learning and learning to do; 7.3.3 Financial management in schools; 7.3.4 Implantation of the integral shift; 7.3.5 Culture of peace in school; 7.3.6 Continuous teacher training; 7.3.7 Integral formation of children and adolescents; 7.3.8 Expansion of supply for nursery and day care; 7.3.9 Installation of multigeracional libraries	Increase accessibility to social service sites and education. Establish an efficient information system, as there is no data on distribution and demand in education, training, health, social services and transportation. Improve human development as it is equipped with a human capital level significantly below the reference value of a group of similar European regions. Improvement of the quality of secondary and	4 5

(continued)

Table 8 (continued)

COREDE Development Guidelines	Projects Corede	Basilicata Development Guidelines	*SDG (ONU)
4. Expansion of vacancies in early childhood education from 0 to 5 years		vocational education. Promote greater cooperation between private companies, universities, provinces and agencies	
5. Dissemination of the inclusive school model			
6. Implementation of the concepts associated with the Educating City			
7. Increase in the economic attractiveness of the rural world for age groups over 40			
1. Leadership training	7.6.3 Training for public managers in the health area	Local governments contribute significantly and efficiently to increasing accessibility to social services and education, because when demand and supply meet at the city level, we need to ensure accessibility within the city. This also presupposes that local authorities are partly responsible for the implementation of Policies in the areas of education, training, social services and, in particular, transport	17
2. Develop sectoral public policies articulated regionally			
3. Implement an exchange program focused on best practices in public management			
1. Implement preventive health policies	7.2.10 Install a social assistance network in Corede; 7.6.1 Qualification of Primary Health Care (PHC) teams; 7.6.2 Qualification of APS infrastructures; 7.6.4 Motolance; 7.6.5 Therapeutic workshops; 7.6.6 Inclusion of mental health in basic health care; 7.6.7 The health academy as a support to combat chronic noncommunicable diseases; 7.6.8 Physician in prenatal care; 7.6.9 Support for better age, a service to the community; 7.6.10 Regional	Increase the quality and availability of social services to meet the needs of children and the elderly and the fight against poverty. Provide qualified health services foreseeing the aging of the population. The elderly population is	3
2. Dissociation of financial resources according to the different types of hospital admission			

(continued)

Table 8 (continued)

COREDE Development Guidelines	Projects Corede	Basilicata Development Guidelines	*SDG (ONU)
	program to combat dependencies; 7.6.11 Support for better age; 7.6.12 Association of new proximity services in response to the need to make local hospitals viable		
1. Increase the sense of security of the populations by the increase of the effective in ostensive operation	7.2.7 Public Policy Forum; 7.4.2 Acquisition of mobile road balances; 7.7.1 Electronic ankle belt integrated into the video monitoring network; 7.7.2 Integration of civilians into the administrative activities of the public security forces; 7.7.3 Renovation of the fleet of public security organs; 7.7.4 Protection system for women victims of violence; 7.7.5 PGI - strengthen to streamline; 7.7.6 Mediation of conflicts; 7.7.7 Recomposition of the cash in the proportion of the outputs; 7.7.8 Electronic insertion of occurrence bulletins (integrated platform); 7.7.9 Safety in school curricula; 7.7.10 Enlargement of video-monitoring; 7.7.11 Regionalization of the 190 emergency number		16
2. Expand the coverage rate of videomonitoring and add solutions to the system to obviate penalties and protect winnings			
3. Strengthen with means and technology the security forces, to fill the shortages of cash			
4. Intervening in schools with education actions for responsible citizenship and security			

*SDG (ONU) Objective
Objective 2. End hunger, achieve food security and improve nutrition, and promote sustainable agriculture.
Objective 3. Ensure a healthy life and promote well-being for all, at all ages
Objective 4. Ensure inclusive and equitable quality education and promote lifelong learning opportunities for all.
Objective 5. Achieve gender equality and empower all women and girls.
Objective 6. Ensure the availability and sustainable management of water and sanitation for all.
Objective 7. Ensure reliable, sustainable, modern and affordable access to energy for all.
Objective 8. Promote sustained, inclusive and sustainable economic growth, full and productive employment and decent work for all.

(continued)

Table 8 (continued)

CORENDE Development Guidelines	Projects Corede	Basilicata Development Guidelines	*SDG (ONU)
Objective 9. Build resilient infrastructures, promote inclusive and sustainable industrialization and foster innovation Objective 11. Make cities and human settlements inclusive, secure, resilient and sustainable. Objective 12. Ensure sustainable production and consumption patterns. Objective 15. Protect, restore and promote the sustainable use of terrestrial ecosystems, sustainably manage forests, combat desertification, halt and reverse land degradation and halt biodiversity loss. Objective 16. Promote peaceful and inclusive societies for sustainable development, provide access to justice for all, and build effective, accountable and inclusive institutions at all levels.			

Source Table adapted by the authors from (Awad, M. et al. 2017)

4 Conclusion

This work established a comparison between the socioeconomic development of Corede Production region in Brazil and the region of Basilicata in Italy. Indicators such as the disaggregated HDI, disaggregated IDESE, demographic evolution, per capita GDP, among others, which in turn have historical and social aspects, are quite different in both territories, in this case the scenarios and the conditions of each region were described. In a second moment an analysis was carried out related to the Sustainable Development Objectives, which in turn shows data referring to the theme.

The societies' engagement is fundamental so that the SDG objectives can be achieved and that more projects could be implemented, supporting the social, economic and environmental pillars.

In this perspective, the establishment of the Sustainable Development Objectives represents a great achievement and challenge for mankind, in order to minimize the instability and implement initiatives for a region, it is fundamental to analyze it, implying in understanding the logic space reorganization, in which it possesses unique characteristics, in the same way, to observe the inequalities that do not imply its homogenization.

Based on what has been explained, the study is part of the regional sustainable concerns, since the analysis of the regions studied, has varied effects on the prospects of local development. It can develop new economic, social and environmental opportunities based on research and the search for sustainable regional development.

In this way, it was possible to analyze the main differences about SDG in the two regions. Initially, while the region of Basilicata is more focused on the social pillar of sustainability, bringing more in-depth data on education and health, the Corede Production region has greater initiatives in the production of grains and cereals, in addition to a greater industrialization process. In a second moment it was possible to analyze that both regions are engaged in the pursuit of the proposed goals, but with intrinsic peculiarities.

Finally, due to the unavailability of some information and the challenge in the search for data of the regions, it is a matter for future work to deepen the themes of the ODSs, which can provide a more accurate profile in diagnosing both in quantitative and qualitative perspectives to generate other constructive conclusions at a regional level.

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Participation in Spatial Planning for Sustainable Cities: The Importance of a Learning-by-Doing Approach

Ann Crabbé, Anne Bergmans and Marc Craps

Abstract Megatrends like climate change, population growth and economic transitions put cities to the test and impact their future. City governments acknowledge the importance of spatial planning to mitigate the problems they are facing, for example by greening the city, infill development, smart reintegration of making industry in the city, etc. Our contribution focuses on the potential of *multi-actor governance* in spatial planning for social learning on these challenges.

For some time now, both in practice as in literature, reference is made to the virtues of 'slow urbanism': projects in which sustainable goals are pursued by means of an inclusive, multi-actor governance oriented and often grassroots' driven approach, contributing to reflexivity, and more legitimate, but also more sustainable and resilient solutions for urban challenges. In this chapter, we put forward the notion of *slow urbanism* as a suited approach for urban planning processes to contribute effectively to creating safer, more sustainable and resilient cities. The implementation of slow urbanism principles cannot only be valuable for district-level initiatives for which it is often promoted. It can also work for creating (fast) large scale

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growth and development of the city and for building resilience in case of unexpected (sudden) events.

Further, we offer guiding principles for participative co-creation processes that facilitate social learning in spatial planning processes. Amongst other principles, we stress and illustrate the importance of: (1) organizing participation in early (pre-draft) stages, (2) a facilitating government, aware of the relevance of a reflexive approach and (3) a learning-by-doing stance towards implementing new and innovative (spatial) solutions.

1 Introduction

Population in cities across the globe is growing, while being increasingly confronted by social, economic and environmental sustainability challenges. Cities of both the developed and the developing world are facing similar challenges such as providing affordable housing for the urban poor, offering education to the city's youngsters, stimulating economic growth and employment through innovation and entrepreneurship, battling pollution, preventing and resisting climate change, improving transportation, supplying sufficient energy, modernizing clean water supply, installing sanitation infrastructure and providing sufficient food to all. In their publication 'The City We Need' UN Habitat states "*How we plan, build, and manage our cities now will determine the outcome of our efforts to achieve a sustainable and harmonious development tomorrow. Well-planned cities afford all residents the opportunity to lead safe, healthy, and productive lives. Well-designed cities present nations with major opportunities to promote social inclusion, resilience, and prosperity*" (UN Habitat 2016). But, achieving sustainable and harmonious development does not just happen overnight.

In order to realize the United Nations' Agenda 2030 sustainability goals (UN 2017) cities have a crucial need for safe, sustainable and resilient infrastructures. From bike paths to sewer systems, from defence infrastructure to resist flood risks to green infrastructure to cope with the urban heat-island effect, infrastructure is a wide ranging topic. Many city governments are developing innovative policies for greater economic and environmental sustainability, investing yearly a good part of all public funding in domains of sustainable infrastructure. This development of sustainable infrastructure is often planned for and mediated by urban planning services.

While urban planning is often considered a governments' task, this chapter underlines that urban planners should strive more towards co-creation between public, private and civil society partners. In order to make infrastructure truly sustainable, there is—in our view—a need for *multi-actor governance*. This means that urban planning is not the responsibility of city governments alone, but that it is a shared responsibility of various stakeholders in an adaptive process of learning-by-doing.

The plea for multi-actor governance and social learning via co-creation of the spatial environment stems from the widely-shared experience that governments tend to develop spatial plans internally, only offering the opportunity for debate in the strictly timed and regulated phase of public consultation. Although public hearings have merits, many problems have been identified as well: people are consulted too late in the process, not enabling early-phased input of bottom-up ideas; there is a bias in the type of participants in these consultation processes (often in Western societies these consultations attract well-educated, senior male inhabitants with time to spare). In short, even when people are invited to participate in urban planning, participation is often very procedural, ignoring structural issues of power play, and neglecting opportunities for including bottom-up ideas and a more diverse set of participants to the urban planning (Huxham 2000; Lewicki et al. 2003).

Two approaches regarding urban planning are distinguished: a traditional approach in which governments have a leading role with an 'instrumental' social function, and an 'ideological' social function (Fischler 2012). The latter corresponds to what other authors refer to as a governance approach in which different actors in a participative way design and decide about urban spaces (Healey 1998; Zellner et al. 2012). However, as Fischler (2012: 110) recognizes, the instrumental and the ideological function of planning have to go together, as urban planning is a means "*to make land usable, to influence its use, to make its allocation among users orderly and to make the resulting spatial order socially acceptable*". If the aim is to make urban planning more sustainable, this should also be reflected in its instrumental function.

Therefore, we argue in this chapter, that participation in spatial planning cannot be restricted to formal procedures for consultation of the public. The emphasis has to be on the informal interactions between different social actors with diverse interests and perspectives. They have to be involved right from the start of the planning process. The focus of the attention has to be on the quality of the dialogue. The high quality involvement of all relevant stakeholders can generate better spatial solutions for complex problems and with broader public support (Innes and Booher 1999).

Literature linking explicitly the terms social learning and urban planning or urban development, is, as Holden et al. (2014) point out, still relatively scarce, but mainly focussed on realising more sustainability in a planning context. Concepts such as *slow urbanism* (Knox 2015; Turkseven Dogrusoy and Dalgakira 2011) put the focus on countering the disruptive pace of economic globalization and consumption culture, linking urban planning to citizenship, culture, social capital and community cohesion, (place) identity, care for the environment and landscape preservation. This corresponds to Fischler's (2012) 'ideological' social function of urban planning and an emphasis on the social construction of place (Knox 2015). Herewith they (implicitly or explicitly) recognize the need to embrace complexity in urban planning processes by means of enabling 'co-creation'.

In Sect. 2 of this chapter we emphasise the importance of social learning in the context of urban spatial planning. We consider social learning a condition for effectively dealing with complex sustainability challenges. In Sect. 3, we offer guiding principles for participative co-creation processes that facilitate social learning.

2 The Role of Social Learning in Urban Planning: When Fast Becomes Slow and Slow Becomes Fast

> Planners who do good urban planning in terms of process help to make planning an opportunity for public learning and public deliberation. They compensate for imbalances of power in society in terms of access to information, to forums of decision making, and to decision makers. They work to make public discussions on urban development issues transparent, constructive, and respectful of differences. (Fischler 2012: 110)

Roggema (2015) distinguishes between fast, slow and sudden urbanism, to address the combined challenges of safe, resilient and sustainable cities and settlements. For this author *fast urbanism* is a top-down and expert-driven approach, based on probability calculation and engineering. It is related to a need for growth and expansion. In a *slow urbanism* approach participation is considered a necessary requirement, to incorporate principles of ecology and social cohesion in urban design. *Suddenism* is defined as a way of adaptive design to incorporate the capability of accommodating the spatial impacts of disasters. Although we find it a useful framework for understanding the challenges and opportunities for urban planning, we find the terminology of 'fast' and 'slow' somewhat misleading. We will argue that fast planning processes may turn out slow and slow urbanism may turn out faster on the long term and lead also to more adaptive capacity for sudden and unexpected events.

Although governmental planners and decision-makers generally acknowledge a need for public engagement, this is often framed in terms of legitimisation and 'creating social acceptance'. This may lead to tensions between a discourse about openness and transparency, and procedures to tame, channel and control participation and to avoid delays in planning large scale infrastructure works (Gardese 2015). A clear example of this tension can be found in the new decree launched in 2014 by the Flemish government to smoothen the procedures for large scale infrastructures of strategic importance[1]: creating space for early engagement in an informal preface to the official procedure, while retaining a very classical public enquiry type of engagement on the actual planning propositions and limiting the possibilities for appeal during the formal procedure (Bergmans et al. 2017). A focus on process efficiency in terms of a swift outcome and an emphasis on technical procedures and legal certainty for project proponents and capital investors minimises the potential for flexibility, reflexivity, and learning-by-doing, leaving little room for social learning.

Ultimately we find more and more examples of a participatory social learning approach in small scale initiatives that eventually aim for an ideological shift in constructing and enacting the city as living space. One such an example is the city of Antwerp's incubator programme, Stadslab2050,[2] which seeks to facilitate the coming together of different partners to develop new ideas for sustainable urban

[1]Decree on complex projects (*Decreet Complexe Projecten*) of 25 April 2014, published in the *Moniteur Belge* of 27/08/2014 (64052).

[2]http://stadslab2050.be/.

development. Several themes and initiatives launched since the start in 2013 have an obvious spatial component (e.g. climate adaptation, greening the city), but are so far not directly linked to formal planning processes. Such a participatory learning approach seems less able to deal with a necessity of growth in both economic and physical terms to provide for the welfare of a growing (urban) population. This is somewhat ironically illustrated by the membership criteria for the slow city movement, Cittaslow,[3] which in principle does not allow cities with more than 50,000 inhabitants as members (Cittaslow International 2014).

A fast urbanism approach indeed still appears to be the preferred answer for complex planning problems that transcend local levels of decision making and imply major urban transformations, including large scale infrastructure works, while a slow urbanism approach is currently still limited to local and small scale initiatives. This is partially due to the fact that many people do not get involved in planning procedures unless they can respond to a concrete proposal, see an opportunity or feel a direct threat to their own situation (Fischler 2012). However it also has to do with the fact that an engineering design approach creates a sense of control, even if in practice that proofs to be an illusion (e.g. Gardese 2015). By focussing on efficiency criteria such as 'on time' and 'within budget', and ignoring (too long) potential conflicts, or setting them aside as particular interests obstructing a higher, general interest, planning procedures risk getting blocked or running into institutional inertia. This is precisely what happened with the attempt to close the Antwerp ring road, most often referred to as the case of the Oosterweel route (see Box 1), where a continuous ignoring of public concerns led to the rising of well organised civil movements resorting to legal actions and a stalemate situation for over 15 years.

Box 1 The closing of the Antwerp ring road: the case of the Oosterweel route

The motorway complex around the city of Antwerp is intensively used by national and international transit traffic, both on the north-south and east-west axes. Up until today, the ring road only consists of a three quarter circle, with a good part of the north-south axis being used by east-west bound traffic. Historically situated within what is now the greater city of Antwerp, the ring road goes straight through a dense urban area. Not only does this attract additional local traffic, it also puts a huge pressure in terms of air pollution on the surrounding and densely populated neighbourhoods.

In the Belgian policy system, roads of supra local importance, are managed at the regional level; in this case the Flanders region. In 2000 a masterplan was put forward by the Flemish Government presenting the closing of the ring road as the answer to all congestion problems in the greater Antwerp area.

[3]Founded in Italy in 1999, this movement counts today 232 member cities in 30 different countries all over the world (Cittaslow International 2017).

In the following years, opposition started to build up, both regarding the location line (the Oosterweel route) and the choice for a viaduct to stretch over part of the city. Whereas those in favour focused on mobility, the opposition focused on viability. Alternative location lines and tunnel projects were proposed, but systematically rejected. In a non-binding referendum in 2009 a majority of the citizens of Antwerp voted against the proposed plans from the regional government. Several environmental impact studies were done and eventually the viaduct was abandoned in favour of a tunnel. However, discussion about the location line remained.

Three well organised civic movements of concerned citizens became key players in the opposition, taking legal action against the government's decisions and pushing for alternative solutions. Drawing on crowd funding and social media, the most recent of the three put forward in 2014 the idea of roofing the entire ring road.

Still refusing to reconsider the location line, the Flemish and Antwerp government picked up this idea and appointed as of January 2016 an "intendant" to investigate the possibility of aligning their preferred Oosterweel route with a roofing in of all sections of the ring road. This team of planners and designers opted for an inclusive process of co-creation, inviting all concerned parties and explicitly the opposing civic organisation to the drawing board. Through a series of workshops, focussing first on the least problematic and building up to the most controversial issues, a first important compromise was reached in February 2017 between the responsible authorities and the opposing movements. Subsequently a new masterplan, or rather road map was proposed as the starting point for the further concrete development of the major goals set: the roofing in of the ring road, the closure of the ring road in two separate sections (one for local and one for through traffic), and the need to come to a 50/50 modal split.

Fischler (2012: 111) states that large scale planning should be flexible in its details and implemented gradually with a build-in learning process to overcome the tension between fast and slow urbanism, indicating haste as "*the enemy of good planning*". As the example of the Antwerp ring road shows, typically fast urbanism problems, can profit from a more open, less technocratic and juridical approach. Slowing down the process and incorporating practices that are attributed to a slow urbanism approach may eventually result in a faster advancement, although not necessarily according to the initial views of the technical planning administrations.

Roggema (2015) points rightly the attention to the need of responding to sudden events or crises. Urban planning and design should not only incorporate preventive measures to counter the risk of negative impacts (e.g. avoiding the creation of heat islands and street canyons, giving back space to natural flooding areas, considering potential security issues when designing public spaces, …), but it should also consider and plan for possible actions such as spatial reservations or intermittent use of urban spaces, and make them an integral part of the urban fabric. This allows a

swift response in case of disasters such as extreme heat waves, storms and flooding. We argue that such an adaptive type of urban design would also profit from a co-creation approach based on social learning. Indeed, by involving a broader scope of actors, the urban planning system becomes more sensitive for different kinds of impacts, but these actors will also learn the how's and why's of measures that can be more rapidly implemented in times of urgency. We find a nice example of such a social learning approach for flooding prevention in the Dijle catchment (see Box 2).

Box 2 Urban flood prevention in the Dijle catchment: social learning for dry feet

In the past the city of Leuven suffered regularly from severe floods by the river Dijle crossing its historical center. To prevent these floods, the public water management administrators designed a dam and emergency water storage basins upstream the city. However, these plans were opposed by a variety of actors and interests. An environmental NGO that managed a wetland area as a natural reserve, precisely where the dam and basins were planned, considered this infrastructure as an ecological threat. It found an ally in the regional drinking water company that feared the pollution of its ground water extraction sites in the same area. The NGO established also a good relationship with the local farmers and with some leisure organizations (biking, walking) in the neighborhood.

Initially the government officials did not consider the environmentalists as legitimate stakeholders and between both sides there was a dialogue of the deaf. However, gradually they learned to understand each other's concerns, the governmental officials because they were confronted with a growing resistance in the public opinion against their plans, and the environmentalists because they were aware that anyhow a solution for the flooding problems in the city was necessary.

First they formed an informal catchment committee in which they started exchanging information and building more trustful relations. The environmentalists studied in-depth the more technical water management issues and some of their members even started a career as public officers in the water administration.

After long discussions a satisfying solution for all concerns was found by developing a completely different plan. It consisted in restoring the original winding and rough course of the river, and in foreseeing space for water in the valley, without pollution or other environmental risks. With these measures there have not been floods in the city of Leuven since almost two decades. The natural reserve is considered as a successful pilot experience for collaborative and sustainable river basin management in Flanders.

3 Participation as Co-creation for Social Learning

In this section we will describe in more detail some basic characteristics of participation as co-creation for social learning, and explain how they apply to the domain of urban planning. These characteristics cannot be considered independently, as they imply and reinforce each other.

3.1 Throughout the Whole Process

Participation cannot be reduced to one or a limited number of isolated moments. Currently there is still a tendency to postpone the involvement of the public, driven by a defensive stance of policy makers. Policy makers, concerned that critique will compromise realization, want to leave their mark on the planning as much as possible. However, if we want to give real possibilities to stakeholders for contributing to the planning process, they have to be fully involved in all phases: participation as co-creation means co-design, co-development, co-implementation, co-monitoring and co-evaluation (Bouwen and Taillieu 2004).

Especially the initial phase of new initiatives is of crucial importance for the participation process, because at that moment there is still a maximum openness to take into account a diversity of perspectives and insights. In this sense, the drawn-out process for the development of the Oosterweel route in Antwerp (see Box 1) can be attributed to a lack of possibilities for participation in the original plans, because of fear for opposition and a one sided focus on the problem at hand. As a consequence, a solution became only possible after many years. A mediator brought all involved parties around the table for a constructive and open dialogue in which formerly taboo propositions became discussable and acceptable.

The joint design of spatial plans is an excellent opportunity to actively involve citizens in the creation of their own life space. There is an increasing offer of so-called large group intervention methods and techniques to work with heterogeneous groups towards shared solutions for complex problems, that have proven their adequacy for urban planning issues, such as search conference[4] (Weisbord and Janoff 2010) and the appreciative inquiry methodology[5] (Cooperrider and Whitney 2005) and others.

[4]For further information, see www.futuresearch.net.

[5]For further information, see www.appreciativeinquiry.case.edu.

3.2 Liquid Civil Society

Participation cannot be limited to the organized civil society. Ad hoc and pop-up initiatives are typical for the current 'liquid society' (Bauman 2000), in which people are temporarily mobilized around issues of common interest, through social media. Digital information and communication cannot be steered and controlled by one actor (Castells 1997). When we conceive participation as co-creation this must not be considered as a problem, but rather as an opportunity for a broad and varied public to take initiatives concerning urban planning. However there are challenges and threats to be taken into account, like the dissemination of misleading information, the exclusion of certain social groups (e.g. elder people making less use of social media), the lock-in effect of people in digital communities with shared opinions and the related hardening of language and positions towards people and communities with other opinions. The organized civil society continues to play an important role in this liquid society, to canalize information and link different communities, as it is illustrated in the case of urban flood prevention in the Dijle catchment (Craps et al. 2005) (Box 2).

3.3 Trans-disciplinary Collaboration

Participation as co-creation cannot be limited neither to professional and scientific experts. Spatial planning in our technocratic society is too often defined by powerful lobbying groups. Economic interests are hidden by supposedly objective studies. We do not want to undervalue the importance of solid studies when complex spatial questions have to be resolved. However, the ambiguity resulting from different disciplinary frames and ideological visions cannot be resolved with more studies, but only with dialogues intending to link in meaningful ways different frames and visions (Weick 2017). Only by integrating all relevant perspectives in the planning process the requisite variety can be reached that is necessary to address the complexity degree of planning questions (Ashby 1958). This is as well a condition to arrive at resilient solutions from a socio-ecological and economic perspective (Folke et al. 2005).

Additionally the objectifying expert knowledge 'from the outside' has to be complemented with the lived experiential knowledge 'from the inside', from people and groups that (will) occupy the space under consideration. A space is not just there to fulfil material requirements, it is as well a carrier of symbolic meanings, reflecting shared histories and storing memories, rendering identity to local communities. Spatial planning processes that do not take into account these sense making qualities will unavoidably lead to alienating solutions and resistance.

Moreover, local inhabitants tend to give more attention to issues of health and liveability of the local environment, than technical experts who are focused on developing infrastructural solutions for problems identified and formulated by the

authorities on a macro-level (Sips et al. 2013). In that way, they contribute not only their experiential knowledge about their own neighbourhoods, but their concerns can also broaden the scope of expertise that is taken into account in the planning process. A nice example of this phenomenon is described by Sips et al. (2013) in the case of an 'Enhanced Landfill Mining project', to dig up and recycle waste from an existing landfill (see Box 3). It was only after the local communities expressed their worries about possible health impacts for the immediate environment, that public health experts were incorporated in the multidisciplinary consortium preparing the project. Health problems due to fine dust particles are a typical issue that local action committees have to bring under the attention of the public opinion, for instance in mobility infrastructure projects like the Oosterweel route in Antwerp, before it is taken into account in the planning process (see Box 1).

Box 3 Enhanced landfill mining in Houthalen-Helchteren, Belgium

The landfill site in Houthalen-Helchteren is one of the three major landfills in Flanders. It is situated in the direct vicinity of three villages and surrounded by an important nature reserve. In the past the neighboring communities had frequently expressed their discontentment because of the stench and heavy traffic hindrance. It was no surprise that they were not happy with the plans to re-open the landfill to extract valuable waste materials and for energy recovery, even if a team of re-known technical specialists (the Enhanced Landfill Mining or ELFM Consortium) was studying mechanisms to do this in the most environmental-friendly way. At the outset, the consortium consisted of scientists from different disciplines, government officials, industrial partners and investors.

The Consortium decided to actively involve the local population in its activities to broaden its scope with local knowledge. By doing so the Consortium strived for a more comprehensive and sustainable project, with broad public support. One of the key players in the history of protests against the landfill was asked to represent the local population in the ELFM Consortium. He decided to organize the local population in a so-called "Locals" group. In the beginning, several of these "Locals" were still very critical and skeptical towards any plan for landfill mining.

The leader of the locals group however made a switch towards a more constructive and dialogical stance. His vision was that one should be open towards facts and knowledge as to understand what is going on. Following that switch, several members of the "Locals" group joined the quest for knowledge and started studying the information provided by the ELFM consortium. A series of shared activities, like a joined visit to a similar initiative abroad with representatives of the locals and of the technical experts, contributed to the quality of the dialogue. At the same time the locals group took care to stay sufficiently autonomous vis-à-vis the promoters of the ELFM project.

One of the results of the local involvement in the Consortium was that new questions appeared on the research agenda, e.g. related to health concerns as a consequence of the eventual emissions of fine dust particles. Public health scientists were incorporated in the Consortium to set up longitudinal studies in collaboration with the local inhabitants.

3.4 Reflexivity

Transdisciplinary collaboration, as we described above, can only be fruitful for the planning process if there is openness to reflexivity among the actors involved (Termeer et al. 2015). They have to reflect actively how they will deal with the ambiguity resulting from the diverse ways of framing problems and appreciating solutions by the different actors (Brugnach et al. 2008; Schön and Rein 1994). Planning experts use a different terminology and action logic than economists, public health, environmental or heritage specialists. Actors tend to control this 'Babylonian' confusion, by reducing a complex problem to what they can translate to their own jargon. Each discipline and interest group constructs a coherent story in its own terminology, for instance about regional economic opportunities, or about a healthy local environment, or about mobility, etc. (Weick 2017). Reflexivity means that the involved actors recognize that different perspectives and ways of framing are relevant. They have to be open to question the implicit assumptions and limitations of their own frames, and engage in a joint search for links, overlaps and complementarities as well as contradictions and conflicts between different frames. This will generate possibilities to find a creative synthesis or new, overarching frames that can lead to innovative spatial proposals. Even when so-called win-win solutions will not always be possible, reflexivity will improve understanding of the contradictions and conflicting interests that are in play. Then it is up to the politicians to take decisions in a more transparent way thanks to the increased insights about trade-offs.

The most important contribution of so-called process facilitators to participation in planning is precisely to stimulate reflexivity in the multi-actor group. Facilitators take care that all relevant actors really listen to each other's knowledge, insights and concerns. Their success not only depends on their personal skills, but also on their perceived legitimacy and neutrality by the other actors. Facilitators can play a key role when the consultation process risks to crash. This is not only the case when there is escalating conflict, but also when there is too less conflict, that is when there is a lack of opportunities for disagreement and opposition. Facilitators are able to re-activate the process with counter-intuitive interventions. For instance, when the relations between the actors are negatively affected by the continuing discussions, they call the attention to the points on which the actors agree. But when delicate topics are avoided in the consultation process, facilitators can bring undervalued

topics under the attention, or they can support weaker parties to express their concerns (Termeer et al. 2015).

In the case of the Oosterweel 'missing link' in Antwerp, the involved parties agree that a facilitator has played a crucial role by creating conditions for a constructive dialogue between them, after many years of mutual deaf conversations. In the case of the earlier mentioned Landfill Mining project, the process facilitators insisted on incorporating representatives of the local community in the multi-disciplinary consortium. Although this proposal was at first received with some resistance, as it threatened the overall consensus about the benefits of enhanced landfill mining, it allowed giving the right attention to formerly neglected public health issues (Sips et al. 2013).

3.5 Learning-by-Doing

The former parts have already made clear that spatial planning as co-creation is not a straightforward process of planning and then implementation of these plans. Co-developing a shared vision, co-designing environments, experimenting with novel concepts, monitoring, evaluation and adjusting implementation are all important but blurred steps in a cyclical process that is permanently iterated. Co-creation is thus not a pre-fabricated but an emergent process, of which not the course nor the end results are predefined at the outset (Stacey 2000). This characteristic is hard to assume for governments, that—properly—consider it as their task and responsibility to control compliance with rules and procedures. However an action logic for control and compliance of existing rules is not suited for the joint development of new rules. We need innovative and locally adequate concepts and frames to respond to the changing local spatial challenges, as a consequence of global economic, social and ecological evolutions and crises. The existing general blueprints are insufficient.

That is exactly why learning-by-doing is so important. Computer simulations can predict to a certain point the implications of certain spatial solutions, but real life social-spatial experiments (living labs) are necessary to offer the involved people the opportunity to appropriate the proposed solutions by trying and adjusting them. As already indicated in Sect. 2, there is a fast growing interest of cities for so-called urban labs for joint learning between municipalities, companies and civil society about integrated spatial solutions for complex and inter-related problems like climate change adaptation, mobility and economic reconversion.

Learning-by-doing implies tolerance for errors and unforeseen negative side-effects. Of course, the risk for undesirable side-effects has to be kept minimal and openly discussed with all involved actors. Effective feedback mechanisms are important to arrive timely at correct learning conclusions for eventual adjustments (Simandan 2011). These learning conclusions should be shared with actors in similar situations elsewhere. However, they do not concern the concrete spatial solutions that were conceived for one place and cannot be copied for other places,

they concern the way towards these solutions, the social process that was followed which can be inspiring for other places (Senge 1990). Custom work, taking into account the specific characteristics of each local situation, is indeed of paramount importance.

The advantage of learning-by-doing is the enhanced responsiveness of local social systems for new situations and challenges (Termeer et al. 2015). When the jointly designed spatial solutions turn out to be insufficient in the future, actors that have learned to collaborate and understand the rationale behind the current spatial solutions, will be better able to jointly arrive at the necessary adjustments and innovations. In that sense learning-by-doing contributes also to resilient spatial solutions (Folke et al. 2005).

3.6 Innovative and Connecting Leadership

Conceiving spatial planning as a joint learning process for co-creation, implies also re-conceiving leadership. Although government has the legal mechanisms and resources to start spatial planning, including the degree and ways of participation by different actors, it cannot guarantee an optimal result in which all perspectives and interests are taken into account. This does not discard a leading role for government in spatial planning, but its traditional 'administrative' leadership has to be complemented with other forms of leadership that favour the innovative potential and involvement of a numerous and diverse group of actors. Uhl-Bien and Marion (2009) identify two additional forms of leadership for complex situations, specifically for innovation ('adaptive leadership') and connection ('enabling leadership'). Nice examples of innovative leadership can be found in various local initiatives and living labs, experimenting with new ways of living together in the urban environment. The diverse constellation of the groups in charge of these experiments makes them sensitive for requirements and expectations in the future, to which they respond in an open and creative way. The ELFM Consortium (see Box 3) is a good example of such adaptive leadership.

Additionally enabling leadership is necessary to link innovative initiatives with governmental or other actors that control important resources and have the positional power to implement them on a wider scale. Enabling leadership consists also in linking different authorities that should be involved in a project, or from their multiple contacts and diverse networks detecting opportunities for new initiatives. It is also necessary to spread new initiatives towards the broader public, creatively involving people in an activating way, by means of for instance interactive websites, workshops, conferences, guided tours, etc. Enabling leadership requires a thorough understanding and broad expertise concerning the proposed innovations, and being trusted as well by the authorities as by the public opinion. E.g. in the case of flood prevention in the Dijle catchment, the environmentalists turned into public officers, played this role of enabling leaders (Craps et al. 2005).

3.7 Vertical Connections

Spatial planning is unavoidably confronted with tensions due to divergent interests among the stakeholders. Planning in a co-creation process means avoiding unilateral decisions and supporting as much as possible the motivation of the stakeholders to dialogue, negotiate, inquire and experiment. This will imply vertical connections between the hierarchical layers of an existing decision structure, additionally to the horizontal linking processes that we have sketched in the former parts. Indeed, stakeholders may lobby at higher hierarchical levels to guarantee their interests in more local (e.g. municipal) projects. This is for instance what the company interested in the ELFM project tried (see Box 3). In that case a good vertical connection is important to tune the visions and efforts of the different administrative layers. Multi-level governance, as this is called, means that different administrative layers are connected to reinforce each other, without higher levels dictating unilaterally what has to be done at lower levels. In practice the higher level will develop policy frames, with general principles and guidelines for lower level authorities, but without precise and detailed instructions how they have to be put in practice. The local governance mechanisms have to be kept empowered so that actors learn that their ideas matter and why and how they are taken into account.

4 Conclusion

In this chapter we emphasise the importance of social learning in the context of urban spatial planning. We consider social learning a condition for effectively dealing with complex sustainability challenges and we offer guiding principles for participative co-creation processes that facilitate social learning.

Urban spatial planning benefits largely from a design strategy based on co-creation. In embracing social learning, it is important not to take a purely instrumental stance and focus on ‘managing stakeholders’. As Sect. 3 argues, co-creative urban planning requires investing in long-term collaborative relations, being open for emerging stakeholders and new legitimate stakeholder claims, including reflexivity, and leaving ample room for experimentation.

We conclude: (a) that finding and creating solutions for urban sustainability problems is not self-evident, (b) that wisdom cannot be provided by one actor alone (e.g. the urban planning city services) but that—in contrast—the relevant expertise and stakes of all stakeholders should be taken along in the planning process, from a very early stage onwards and (c) that there is a need for an adaptive co-learning process in which stakeholders keep interacting during the entire process and in which plans can be adjusted to changing circumstances.

For some time now, both in practice as in literature, reference is made to the virtues of *slow urbanism*: projects in which sustainable goals are pursued by means of an inclusive, governance oriented and often grassroots’ driven approach,

contributing to reflexivity, more legitimate, but also more sustainable and resilient solutions for urban challenges.

There are plenty of examples (the Oosterweel case—see Box 1—being one) in which *fast urbanism*—where (city) governments, together with experts, aim to provide rapid answers to pressing problems by means of top-down managed urban planning processes—turns out to deliver slow processes, with a lot of inertia and tense relations between governments and stakeholders.

Rather than presenting it as an alternative approach, only valid in particular circumstances (e.g. only in smaller urban areas (Cittaslow International 2014) or at particular times (e.g. during economic stagnation, as suggested by Roggema 2015), we prefer to put forward the notion of slow urbanism as the standard approach for urban planning processes to contribute effectively to creating safer, more sustainable and resilient cities.

Slow urbanism if interpreted as an inclusive governance approach, based on the characteristics described in Sect. 3, is not only valid for solving small town or district-level problems, but also for dealing with city-wide and metropolitan challenges. Such an approach is not as slow as the term seems to indicate. Investing in processes in which multiple stakeholders are engaged in (mid) long term learning processes, has the advantage that—when new challenges pop up—the necessary governance structures and collaborative competences are present to cope with these new challenges. Slow urbanism thus links up with *suddenism* situations in which urban populations need to deal with ad hoc, invasive new trends or events. Investing in slow urbanism further stimulates developing legitimate pro-active strategies to deal with sudden disruptions, what makes cities better resilient.

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The Urban Planning Guided by Indicators and Best Practices: Three Case Studies in the South of Brazil

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Abstract The rising number of people in the world living in urban areas has been a challenge for scientists, technicians in urban planning, public management and communities in general. This is because cities are increasingly concentrating on urban space and there is a need to ensure quality of life in the urban environment through urban infrastructure. The purpose of this paper is to address the importance of integrated learning (university vs. community) to transform cities into healthy environments. The methodology of this work is based on analysis of secondary data. The case study areas were three polo cities in the South of Brazil. The phases of the research are structured in three. First, identification of urban planning indicators that contributes to a healthier environment. Second, survey of "good practices" (successful case studies at national and international level), aiming at the sustainable transformation of cities by analyzing the applicability of the cases to the municipalities studied. The third stage was marked by interaction with the community, in which there was selection, discussion and learning in the face of more sustainable urban planning techniques. The results indicated problems in current urban planning, especially regarding areas and green coverage indices, healthy urban environment indicators. Also, the insertion and monitoring of urban planning indicators are indispensable factors for good management and quality of life in cities. Finally, the community realizes the importance of inserting best practices for urban sustainability, combating climate change and developing resilience.

Keywords Cities · Urban planning · Sustainability · Indicators

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1 Introduction

The concentration of individuals in urban space is a phenomenon that belongs to the twenty first century, at no other time in history people has been so much concentrated, in the same environment. Today, 54% of the world's population live in cities and surveys indicate that this percentage will increase. At the end of the twentieth century (1995) there were 22 large cities and 14 megacities on the planet, twenty years later (2015) these numbers went to 44 and 29 respectively (United Nations 2012).

There are questions that sum up the misgivings of planning the cities of this century, they are: Are the cities prepared for this growth? Do they present infrastructures, public management, governance and opportunities for all? Do they ensure quality of life? Facing these arguments, research affirms the importance and influence that the urban environment exerts under human beings. In this sense, "concrete and asphalt cities" have negative impacts on the environment and on the health of its inhabitants. Herzog (2013) states that there are indices of diseases linked to lack and/or absence of contact with green areas, the practice of outdoor physical activities, quality food, relaxation and unsafe distraction in environments urban areas lacking healthy planning guidelines and strategies. And, this restriction of the dynamics with nature and cities raises the indexes of diseases, such as: obesity, high blood pressure, anxiety, depression, cancer, panic syndrome, and even suicides, as cities become more globalized. He also says that sustainable cities depend on healthy ecosystems.

According to the World Health Organization (WHO 1995) for a city to be or become healthy, it must incorporate into it's planning ten guidelines, described below, that contribute to the better development of economic, environmental and social systems. For a healthy urban environment it is necessary: (1) a clean and safe physical environment; (2) a stable and sustainable ecosystem; (3) high social support, without exploitation; (4) high degree of social participation; (5) satisfied basic needs; (6) access to experiences, resources, contacts, interactions and communications; (7) diversified and innovative local economy; (8) pride and respect for biological and cultural heritage; (9) health services accessible to all and (10) high level of health.

Understanding that cities need to be healthy so that the quality of life of their inhabitants is enhanced is necessary. In this context, municipal public management and local governance play a key role in processes that ensure and/or prevent healthy cities. This is because addressing the perceptive approach of sustainability-oriented city planning must be more than a partisan electoral plan. It should be, first and foremost, a proposal for healthy development for all, structured in partnership with the local community and that surpasses electoral periods and political killings (Adriano 2000).

There is no possibility of isolating the theme city and quality of life in the urban environment. These factors have direct relationships. According to Gehl (2015) cities should be designed for people. Therefore, urban planning must frame

strategic forms and ensure the movement of urban goods and services on foot. Only in this way will cities be: "alive, safe, sustainable and healthy".

For Turkoglu (2015) the classification of a sustainable community is directed at how it uses natural resources and preserves them in order to ensure their access to future generations. In this way, there is sustainable development concept is present in the context of sustainable communities. Moreover, these communities increase the quality of life while ensuring the same for their misunderstandings.

However, in order for communities to achieve sustainability and be healthy places, there must be knowledge dissemination techniques (Turkoglu 2015). And yet, this knowledge must be improved throughout life and passed on from generation to generation through a process of continuous education. In this sense, universities play a crucial role in producing and disseminating knowledge, especially for the regions where they are inserted. Over the last forty (40) years, the United Nations Educational, Scientific and Cultural Organization (UNESCO) and other major international agencies have implemented the "lifelong learning" approach in most Higher Education Institutions (HEIs) are partners in this journey (Duke and Hinzen 2014).

In 2013 in Hong Kong, the Cities Conference with the "Learning Together" sub-theme discussed the integration between the different sectors of the urban environment (central, local, economic, social, public, private, civil society and universities) and sustainable development. The intuition of the discussions was to understand the different techniques and practices of success in urban planning. That could be applied in different cities around the world in the short, medium and long term. In this sense, the universities, present, shared scientific knowledge and everyday community experiences (Duke and Hinzen 2014).

Therefore, the purpose of this chapter is to address the importance of integrated learning (university vs. community) to transform cities into healthy environments.

2 Methodology

Initially, it is worth mentioning that this research is an integral part of a research project called PRESUST (Prerequisites for Sustainability of Municipalities in Rio Grande do Sul), which was carried out in partnership between the Universities framework (HAVE, UFSM, UFRGS and UPF). The project raised indicators, practices and carried out the training of individuals in three cities in the State (Porto Alegre, Santa Maria and Passo Fundo) focusing on six themes (energy, urban planning, mobility, solid waste, socio-environmental and education for sustainability). Which if well planned contribute to the sustainability of cities. Thus, this chapter addresses the issues of urban planning and interaction with the research community. Figure 1 represents the methodological framework of the research, divided in three stages.

Figure 2 and Table 1 identify and characterize the study areas (FEE 2017a, b, c).

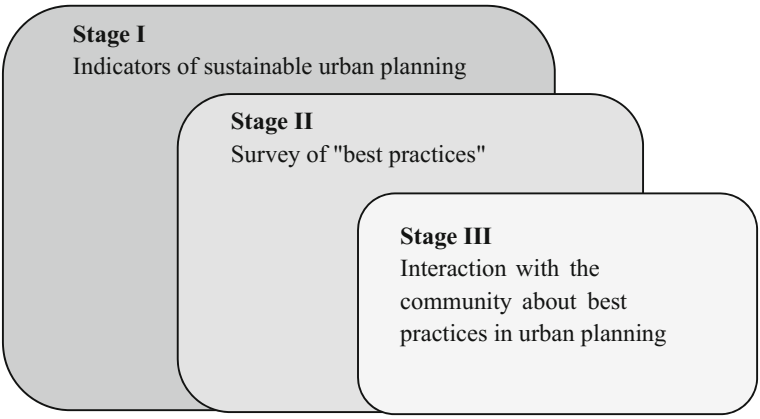

Fig. 1 Methodological outline of the research

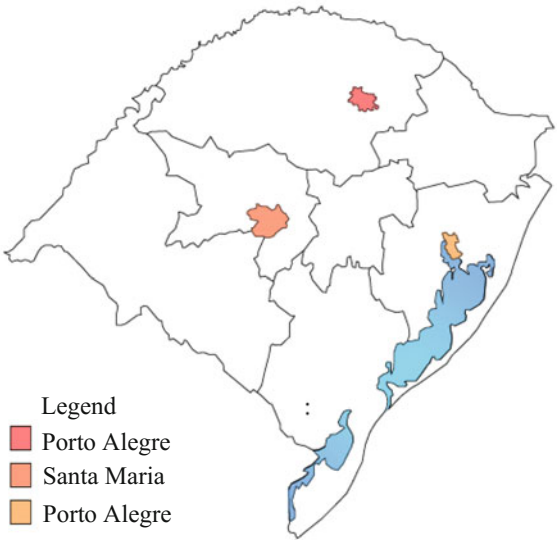

Fig. 2 Location of study areas on the map of the state of Rio Grande do Sul

Table 1 Demographic characteristics of cities under analysis

Demographic characteristics	Porto Alegre (Large sized)	Santa Maria (Medium sized)	Passo Fundo (Medium sized)
Total population (2010)	1.409.351 inhabitants	261.031 inhabitants	184.826 inhabitants
Area (2010)	496,682 km²	1.781,757 km²	783,421 km²
Demographic density (2010)	2.837,53 in ha/km²	145,98 in ha/km²	235,92 in ha/km²

Table 2 Methodology and indicators selected for diagnosis

Indicator	Code	Fraction	Components	Unit
Index of green area	1	Numerador	Square meters of green area (m^2)	m^2/inhab.
		Denominador	Number of inhabitants (inhab.)	
Index of green coverage	2	Numerador	Hectares of urban territory with green cover—any public or private permeable space (ha)	(ha)/ (ha) × 100%
		Denominador	Total urban area (ha)	
Reserved/Protected areas	3	Numerador	Hectares do território com finalidades de conservação (ha)	(ha)/ (ha) × 100%
		Denominador	Total area of the municipality (ha)	
Urban public spaces	4	–	Existence of urban public spaces —squares and parks	–
Resident population by area: urban; subnormal and rural	5	–	Total population of the municipality and its distribution by area: urban, subnormal and rural	–
Governance in public management	6	–	ONGS e associações: sua contribuição para a governança do ambiente urbano	–

Sustainable urban planning indicators were selected based on the precepts studied by national and international organizations (the Sustainable Cities Program, the Ministry of Cities, the United Nations Development Program and the United Nations) from the perspective of cities Sustainable and/or healthy. Faced with this, many could have been the indicators selected for the study. However, interest was directed at: green areas, public spaces, population distribution by area and local governance. Thus, six indicators of analysis (Table 2) were selected, which are directly related to: availability of secondary data, urban environment, social inclusion, governance and public management. All these variables collaborate with each other to characterize the urban environment and quality of life in cities.

2.1 Methodological Limitations

The survey of urban sustainability indicators (first stage of the research) presents limitations because the methodological base is structured under the analysis of secondary data. The second stage does not present methodological limitations since the selected indicators gave subsidy to the identification of best practices. The third stage, which was the interaction process with the local community of the three study areas, presented challenges regarding the commitment of the Stakeholders to participate frequently in the training.

3 Results and Discussions

3.1 More Sustainable Urban Planning Indicators

According to the methodology proposed in Table 1, the results of the indicators for the study were presented and discussed. The first indicator of analysis was the green area index per capita. The same is the result of the total square meters of public green areas (squares, parks and flowerbeds) divided by the total urban population. Table 3 shows the index of green areas in the three study areas in the year 2013, considering the urban population of the same period (Benetti 2013; Rocha and Werlang 2005; OBSERVA POA 2010).

Porto Alegre is highlighted, since it presents the equivalent of 44.62 m^2 of green area for each of its inhabitants. This because, Porto Alegre is located on the banks of Lake Guaíba and, therefore, has extensive linear parks on the river lake, which contributes to raising this indicator, as well as internal parks delimited for decades in the municipality's master and environmental plans. While Santa Maria and Passo Fundo present worrying data (0.59 and 0.97 m^2, respectively), well below the minimum recommended by the World Health Organization (12 m^2 of green area for each inhabitant). In this sense, the greater the availability of square meters of green area per inhabitant in the cities, the greater the quality of life of its inhabitants and the urban environment.

For Costa (2010), green areas in urban areas, as places of leisure and recreation, have the capacity to neutralize, through relaxation, stressful urban factors such as noise, heat and air pollution. However, the implantation of green areas in the urban space must develop in a planned and preserved way over time. Thus, cities will have larger permeable areas, reducing the risks of floods and environmental catastrophes (Sustainable Cities 2012).

The green coverage index, according to the indicator, corresponds to the total of any urban area (public or private), in hectares, free of construction and permeable, divided by the total hectares of the territory under analysis and multiplied by one hundred. Table 4 shows the values of the per capita green coverage index in the downtown neighbourhoods of Porto Alegre, Santa Maria and Passo Fundo in 2010 (Benetti 2013; Rocha and Werlang 2005; OBSERVA POA 2010).

The downtown neighbourhood of Passo Fundo has the highest index of green coverage (14.63%) among the three cities (Santa Maria, 7.2%, and Porto Alegre, 8.02%). This is because there is a large presence of vegetation on the sidewalks in central on city in Passo Fundo. According to Lombardo (1985), in order for the

Table 3 Green area index per inhabitant

Index of green area per inhabitant (m²/inhab.)	
Municipality	m² of green area (2013)
Porto Alegre	44.62
Santa Maria	0.59
Passo Fundo	0.97

Table 4 Index of green coverage in the centre district

Green coverage index (%)	
Municipality	GCI in 2010 (%)
Porto Alegre	8.02
Santa Maria	7.2
Passo Fundo	14.63

adequate thermal balance to occur in urban areas, it is recommended that the green coverage index be at least 30%. Still, in the areas with results below 5%, the climatic characteristics resemble deserts. In addition, this factor directly interferes with the ventilation, permeability, luminosity and thermal comfort of urban areas.

The third indicator refers to the preserved areas in the urban and/or municipal territories are alternatives of sustentation and balance between the constructed environment (city) and the natural environment. Table 5 shows the percentage of areas preserved in the Atlantic Forest Biome of the entire municipal territory (INPE and SOS Mata Atlântica 2014).

Passo Fundo presents only 6% (46,768 km^2) of its preservation areas, a fact that warns of the importance of environmental inspection as well as the need for recovery of preservation areas (Rio Grande do Sul Public Prosecutor's Office 2009). The Santa Maria situation also requires attention because it presents only 16% (38,551 km^2) of the total protected areas in its territory. The case of Porto Alegre is somewhat favourable, with 32% (155,824 km^2) of protected reserve areas, when compared to the other two study areas (Passo Fundo and Santa Maria). It is believed that, Porto Alegre presents greater preserved areas due to the presence of the environmental master plans and the greater concentration of the inspection bodies in relation to illegal deforestation activities.

According to the Food and Agriculture Organization of the United Nations (2015), to extend and protect the areas of preservation of a territory is a primordial factor of existence and eco-systemic equilibrium. Still, the ideal for a city to be or become more sustainable is that it does not present deforestation indices in its preservation areas, conserving to the maximum the native vegetation and the natural environment.

The fourth indicator quantitatively evaluated the urban public spaces—squares and parks in the study areas (Table 6) such as squares, parks, public gardens, recreation areas among others of access to the inhabitants, which are indispensable for the qualification of the urban environment, social integration and increase of the quality of life and environmental regeneration in the cities (Municipal Prefecture of Porto Alegre 2016; Municipal Prefecture of Santa Maria 2016; Benetti 2013).

Table 5 Preserved areas of the Atlantic Forest Biome

Preserved areas of the Atlantic Forest Biome (%)	
Passo Fundo	6
Santa Maria	16
Porto Alegre	32

Table 6 Availability of urban public spaces

Availability of urban public spaces		
Town	Square	Park
Porto Alegre	9	316
Santa Maria	1	51
Passo Fundo	1	17

The presence of squares in the study areas is greater than that of parks, in all cities. However, the availability of squares and parks proves insufficient for the three areas. A fact that identifies the limitations of existing recreation areas (squares and parks), in commemorative days or municipal holidays, where people look for these places and their limitations are shown in front of the dimensions of the green leisure areas. Still, based on Table 1, both cities in the study concentrate a large number of inhabitants, ranging from one hundred and eighty-four thousand to over one million, and the ideal for a healthy urban environment is that its inhabitants find a park and/or a square within a minimum radius of 200 m, which is the area of direct influence thereof—squares and parks (Santos et al. 2013).

The study of the resident population by urban, subnormal and rural areas was the fifth indicator of the research and analyzed the distribution of the municipal population of each study area (Table 7) (IBGE 2010a, b, c, d, e, f).

In 1999, Porto Alegre (capital of the state of Rio Grande do Sul) approved its Urban Environmental Development Master Plan, authored by the municipal Executive of the time, which classified the entire territory of the capital as urban. However, the South Zone of Porto Alegre presents large areas of properties with rural characteristics. Due to this constraint, all the population currently counted by IBGE in Porto Alegre is urban. According to Table 6, Porto Alegre has a 100% urban population (1,409,351 inhabitants), of which 13.67% (192.799 inhabitants) are residents of subnormal areas.

Santa Maria has a high rate of urbanization, equivalent to 95.15% (248,347 people) of its population living in the urban area. Of this total, 5.4% (13,390 inhabitants) are residents of subnormal areas and survive on the edge of society. Still, the rural population of Santa Maria corresponds to only 4.85% (12,684 individuals) of the total population of the municipality.

The municipality of Passo Fundo has the second highest rate of urbanization, among the three study areas, equivalent to 97.45% (180,120 people). Of these, 1.08% (2014 people) inhabit subnormal areas within the urban area. Passo Fundo presents only 2.55% (4706 people) of its total population living in the rural area.

Table 7 Population distribution

Population distribution (%—2010)			
Population	Urban	Subnormal	Rural
Porto Alegre	100	13.67	0
Santa Maria	95.15	5.4	4.85
Passo Fundo	97.45	1.08	2.55

Table 8 Entities and good governance in the study areas

Non-profit entities for urban improvement	
Municipality	Number of entities
Porto Alegre	297
Santa Maria	37
Passo Fundo	36

In the study areas, urbanization has already exceeded 95%. These results are worrisome, since the rates presented are well above the state indices (85.1%), national (84.4%) and world (54%). All this, alert to the challenges that will be to organize healthy urban environments increasingly dense and complex.

The last indicator, the sixth one, refers to governance in public management. This means the sum of the many ways for individuals, institutions and non-governmental organizations (NGOs) to plan and manage the common issues of the city. Thus, the indicator analyzed in a quantitative way the number of non-governmental entities in the study areas (Table 8) (ONG BRASIL 2016a, b, c).

Porto Alegre has the largest number of nongovernmental entities (297), followed by Santa Maria (37) and finally Passo Fundo (36). Good governance tends to: promote equality, participation, pluralism, transparency, accountability and the rule of law in an effective, efficient and sustainable manner by integrating public management and the local community towards a common goal of 'improvements in the urban environment'. In this sense, NGOs, associations of neighbourhoods, residents, among other entities; Play critical roles in the resilience of the urban environment and sustainability.

3.2 Stakeholder Participation

The interaction process with the community in the three study cities was carried out throughout 2015. In both study areas, stakeholders formed groups with different representative fronts, such as: civilians, neighborhood associates, NGOs, managers, public officials and others.

During the training process of these individuals, a number of practices were presented aimed at more efficient and sustainable urban planning. Moreover, these practices presented different degrees of feasibility of application and were classified under two levels—individual and public management (Table 9).

It should be emphasized that the selection of the practices identified by the participants was directed to the local problems of their municipalities and, mainly, with emphasis on their neighborhood and/or meeting place of the group for the training.

Table 9 illustrates the best practices at the individual and public management levels selected by the majority of Stakeholders in each study city, pointed out during the most important and different levels of training (individual and public management).

Table 9 Stakeholders perception of urban planning practices

Level	Cities of study		
	Porto Alegre	Santa Maria	Passo Fundo
Individual	I. Take care of sidewalks and streets, do not throw garbage; II. Participate in public management; III. Execute more permeable sidewalks; IV. Carrying out voluntary work.	I. Do not waste water (wash the sidewalks with reusable water); II. Take care of sidewalks and streets, do not throw garbage; III. To carry out voluntary work; IV. Participate in public management.	I. Take care of the sidewalks and streets, do not throw garbage; II. Do not waste water (wash the sidewalks with reusable water); III. To value public spaces (squares, parks and urban rivers). IV - Participate in public management.
Public management	I. Institution of the Green IPTU; II. Implementation of green agriculture.	I. Institution of the Green IPTU policy; II. Urban densification - Implementing urban agriculture.	I. Creation of a green town planning policy; II. Creation of the LEED certification; III. Institution of the program for the recovery of degraded areas.

Based on Table 9, it is evident that the Stakeholders are concerned about the urban environment by committing themselves to keep the urban space (sidewalks) clean and adequate, not to waste water. With regard to public management practices, the participants emphasized the policies of implementing green urbanism, thus showing concern for the urban environment and the natural environment.

It is also important to emphasize the importance of urban green areas and spaces, both in scientific theoretical terms and emphasized by the Stakeholders for the existential needs of contact with nature. For Turkoglu (2015) green areas have a great contribution to the qualification of the urban environment and to the quality of life, making cities healthier environments.

3.3 Choice of Best Practices

The suggestion of six best practices for both city of study was made by the researchers and presents a direct relationship with the study indicators of the first methodological stage. For example: first indicator—index of green area: how can be to increase the index of green areas in the cities under study? With the search of practices and bibliographic review, the authors suggested the following practice: To implant green areas in urban space. And then they presented the benefits of this practice for the sustainable development of cities and this analysis was performed for the five other study indicators (Table 10).

Table 10 Best practices in urban planning in response to indicators

Description of indicator × practice	Contributions to sustainable development		
Indicator 1—Green area index *Practice:* Deploy green areas in urban space (Chiesura 2004; Ahern 2007)	**Environmental effect** Reducing CO_2 emissions, environmental impacts and landscape improvement	**Social effect** Environmental education, increased quality of life and social integration	**Economic effect** Valorisation of the urban environment
Indicator 2—Green coverage index *Practice:* Deploy green roofs on buildings (Mentens et al. 2006; Oberndorfer et al. 2007)	**Environmental effect** Purification of the air, reduction of urban noise level, softens the local temperature and enhances the absorption of rainwater	**Social effect** Integration between urban environments, built, natural and human	**Economic effect** Financial economy in energy costs inside buildings
Indicator 3—Preservation areas *Practice:* Preserve and conserve green areas. (Rudd et al. 2002; Alvey 2006)	**Environmental effect** Preservation of water sources, local fauna and flora and water quality	**Social effect** Greater quality of life in the urban environment. Reduction of urban epidemics from floods	**Economic effect** Reduction of water treatment costs and losses in distribution systems
Indicator 4—Urban public spaces *Practice:* Requalification and expansion of urban public spaces—parks and squares (Chiesura 2004)	**Environmental effect** Qualification of the urban environment, expansion of green areas in cities and greater urban permeability	**Social effect** Extension of areas of coexistence and social integration	**Economic effect** Reduction of investments in public security ensured by the occupation of urban space by individuals
Indicator 5—Resident population by area *Practice:* Requalification and expansion of urban infrastructures for all (Blanco and Kobayashi 2009)	**Environmental effect** Reduction of environmental pollution (lack of basic sanitation). Improvement of the urban landscape and creation of positive local identity	**Social effect** Reduction of social inequalities, poverty and violence and encouragement and strengthening of citizen participation	**Economic effect** Reduction of investments in public security and reduction of crime rates
Indicator 6—Governance in public management *Practice*: To actively involve local leaders and stakeholders in urban planning processes (Hartley 2010)	**Environmental effect** Revitalization of the river, valorization of the water resource and integration between the urban environment and the environment	**Social effect** Environmental education, local empowerment, awareness of the importance of part	**Economic effect** Reduction of investments of public resources

Urban planning practices are indispensable tools for transforming the urban environment to assist public management and are efficient means of building more sustainable and healthy cities. However, for the post-implantation success of urban planning practices, it is necessary for the local community to become involved in the participatory process of selection, communication and learning about the implementation and positive impacts of the same. This is because, it is the individuals who ensure the quality of urban space through their choices and daily acts.

4 Conclusions

The accomplishment of the field work that generated the interaction with the stakeholders gave the empirical knowledge, based on the personal and daily questions of the group discussions during the training process. As a result, the exchange of information between the local community and researchers was relevant, bringing good learning results and awareness of the study groups to the issues that involve more sustainable urban planning. Also, it was evidenced that the group's main concern is the green areas in the cities and both show positive perspectives regarding the implantation and its preservation.

The results raised by this research need to be accompanied by public management in order to change worrying scenarios, such as green coverage rates and areas preserved in the territory. In addition, urban planning practices are alternatives that if implemented will contribute to good urban planning and to improve the quality of life in cities.

However, the effective participation of NGOs, neighbourhood associations, councils, and other civil society representatives interacting with the government sector are fundamental to the success, sustainability, resilience and health of urban environments. In this way, they are considered healthier spaces to the conviviality and the integration of its inhabitants.

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Part II
Healthy Cities and Healthy Environments

Nature, People and Place: Informing the Design of Urban Environments in Harmony with Nature Through the Space/Nature Syntax

Karen Munro and David Grierson

Abstract The Biophilia Hypothesis holds that there is a connection between humans and Nature which is innate: that when this connection is provided the human mind performs at peak, and when it is absent the mind is in a state of deterioration. Increasingly research supports the Biophilia Hypothesis: studies show that a connection to Nature provides psychological, physical, and emotional benefits. Concurrently, the world's urban population is rapidly growing and is expected to reach 70% of the world's total by 2050. Thus a dichotomy emerges: how do we maintain this vital and valuable human connection with Nature in an increasingly urbanising world? Building on previous preliminary publications, this chapter will update the findings of a novel, cross-disciplinary methodology called Space/Nature Syntax as developed and applied at Arcosanti's "urban laboratory" in the Arizona desert. The findings, which support relationships between visual connectivity to Nature and certain social interactions, present a unique understanding of the influence of Nature on human interaction with people and place. It will also present how informed design can fulfil the biophilic need and allow for the essential human/Nature connection to thrive, taking steps towards understanding how cities can be built in harmony with Nature.

Keywords Biophilia · Connectedness to nature · Urban public space
Spatial analysis · Space syntax · Social interaction · Observations
Environment related behaviour

1 Biophilia and Urbanisation

This chapter derives from research which has developed the Space/Nature Syntax, a methodology that explores what effect proximity to the natural environment from the built environment has on social interactions, with Arcosanti, Arizona, USA as case

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study. We will present the findings of the Space/Nature Syntax application at Arcosanti within the context of current knowledge of human interaction patterns within urban public spaces. The work aims towards identifying opportunities for informed design to increase visual contact with nature within built environments, in turn preserving and enhancing our biophilic connections, and facilitating social interactions.

In 1984 the Biophilia Hypothesis was proposed by E.O. Wilson as an evolutionary theory which presented the relationship between humans and Nature as innate. Wilson proposed that we are born with basic mental facilities which are awakened and stimulated through contact with the natural environment. When this natural contact is provided the mind can develop and thrive; when contact is absent the mind is mentally deprived (Krčmářová 2009; Clowney 2013). Recent scientific studies increasingly support the Biophilia Hypothesis; contact with the natural environment is repeatedly shown to decrease stress, symptoms of mental illness, and recovery times in hospitals, and increase concentration in school children and happiness in workplaces (Frumkin 2001; Taylor et al. 2002; Giles-Corti et al. 2005; Matsuoka and Kaplan 2008; Taylor and Kuo 2009; Barton and Pretty 2010; Nisbet and Zelenski 2011; Logan and Selhub 2012; Beil and Hanes 2013).

Paolo Soleri, an Italian-American architect, artist and philosopher began the construction of Arcosanti in the Arizona desert in 1970, as an "urban laboratory" (Soleri 1993) designed and built according to the principles of Arcology, Soleri's proposal for designing cities that achieve an equilibrium between humans and Nature. Soleri's Arcology (ARChitecture + ecOLOGY) theory calls for cities that are three dimensional, compact and vertical, providing the high density environment he felt was essential while minimising ecological impact. Additionally, vehicles would have no place in an Arcology, with the proposed transit methods being walking and cycling, thus the city would return to being designed around the human, not the automobile. Soleri's Arcology theory goes beyond an urban planning theory, embodying an evolutionary theory which he named the Miniaturization-Complexity-Duration (MCD) paradigm. The MCD paradigm holds that, in order to ensure that our evolutionary potential is achieved, humankind needs the kind of close contact with other humans that dense, compact arcologies would provide (Soleri 1969; Soleri and Strohmeier 2001; Soleri and Sarda 2007; Soleri et al. 2012; Soleri and McCullough 2012) (Fig. 1).

The theories behind Biophilia and Arcology align when considered alongside the shift from rural living to urbanisation that has been underway since the Industrial Revolution. In 2008 over 50% of people on the planet were living in cities, and it has been projected that by 2050 this figure will be 70% (P.R.B. 2008; W.H.O. 2014). This shift of population towards cities is coupled with a general rise in total world population. In 2011 the global population reached 7 billion; in 2016 it was estimated at 7.3 billion (UNFPA 2015a). By 2050, the UN estimates that the global population will be 9.6 billion: if this projection proves to be a reality, and the projection of the World Health Organisation that 70% of the world's population will live in cities also holds true, then this will translate to a global urban population of 6.7 billion—almost double the 3.4 billion urban inhabitants in 2008 (Berry 2008; UNFPA 2015b). The potential economic, cultural, political, and social benefits of urban living have increasingly drawn people to the urban environment. This means increasing numbers of people

Fig. 1 Arcosanti. *Source* Author

who seek all the things city life has to offer are also in danger of sacrificing their biologically essential connection to the natural environment.

Where Wilson believed that proximity to Nature is beneficial, innate, and essential, Soleri's Arcology theory and MCD paradigm holds that proximity to both Nature and fellow humans is beneficial, innate, and essential, and offers a more rational planned response to the challenges of our age (Grierson 2016). The natural environment is not designed for humans: when in Nature humans are a part of a larger biological system which doesn't and shouldn't put our needs first. But since cities are designed by and for humans, to be designed well they must address our various and complex needs. With strong scientific support for the Biophilia hypothesis, it is becoming increasingly evident that, alongside our physical and social needs, we have a biological need for Nature to be present in our cities. Arcosanti, a 15-acre settlement surrounded by over 800-acres of protected natural landscape (Cosanti Foundation 2013), provides a timely opportunity to explore how humans respond to experiencing simultaneous built and natural environments, and explore how such a settlement can inform city design that provides physical, social and biological needs.

2 Social Interactions in Built and Natural Environments

Proximity to Nature, and the effect of this on humans, has become a significant field of scientific study in the last 40 years. Yet the majority of studies on the human-Nature relationship still focus on health benefits, with the effect on social interactions usually limited to a side point within a wider study. Those which do touch upon social interaction raise an intriguing duality with regards to how people

Fig. 2 Social events at Arcosanti. *Source* Author; Cosanti Foundation www.arcosanti.org

interact with others when in Nature. There is a strong narrative of people viewing Nature as a place for solitude and respite yet also a strong narrative of people viewing Nature as a place for gathering and socialising (Barnhart et al. 1998; Jim and Chen 2006; Kingsley et al. 2009; Peschardt et al. 2012; Rostami et al. 2014; Baklien et al. 2016). While the majority of studies are set in a natural environment there are similar results from studies looking at urban nature. Urban public space use was suggested to be influenced or linked to natural elements: where there was grass or water in public spaces, there tended to be people, and again the conclusions were mixed with some researchers linking the natural elements as appealing for solitude and peace, and others to socialisation particularly through children playing (Coley et al. 1997; Roovers et al. 2002; Huang 2006; Dowdell et al. 2011) (Fig. 2).

In the midst of a city true Nature is unachievable: even the most famous and loved public urban parks like Central Park in New York or Hyde Park in London are man-made Nature. Yet, there is evidence which points to man-made Nature as still having the potential to trigger biophilic responses: studies which consider small interactions with natural elements within the built environment achieved similar results to those which explored biophilic responses in "true" Nature or wilderness (Heerwagen and Orians 1986; Salonen et al. 2013). This discovery is significant when considering the juxtaposition between Biophilia and urbanisation: while it may be impossible to provide true Nature in an urban environment, it is certainly possible to integrate natural elements which appear to have the potential to produce similar biophilic responses, and thus achieve the proven psychological and physiological benefits.

Additionally where physical access to Nature is difficult or impossible, a view of Nature has been suggested to have similar if not identical benefits (Hartig et al. 2003; Stigsdotter 2004). In fact, a number of studies found that merely looking at images of natural scenes produced the same psychological reactions and physical benefits that taking a walk in a forest would achieve (Ulrich 1979, 1984;

Ulrich et al. 1991; Sherman et al. 2005; Raanaas et al. 2012). Thus the potential of a visual connection to Nature emerges as an exciting prospect when related to urbanisation and increasing Biophilia within cities. A view of Nature, however, has never been explored alongside social interaction: there were no studies identified through this research which sought to establish if viewing Nature influenced social activities and human behaviour in the same way as physical access to Nature. This is a particularly significant opportunity for exploration given the aforementioned duality in the relationship between social interaction and the human-Nature relationship.

3 Towards a Space/Nature Syntax Methodology

The methodological development of the Space/Nature Syntax has been published previously: these can be referred to for full details of its components and how they are calculated (Munro and Grierson 2016; Munro and Grierson 2017). There are four components which will be described and referred to throughout the paper: **Space Syntax**; **Nature Syntax**; **Interaction Observations**; and **Correlations**. The Space/Nature Syntax evolved from Space Syntax, a method of spatial analysis developed by Hillier and Hansen (Hillier et al. 1976; Hillier and Hanson 1984; Hillier 1999; Hillier 2007) which gives statistical value to built spaces, allowing them to be analysed, adapted and planned by investigating the relationships between spatial layout and social, economic and environmental urban issues (UCL 2016). Space Syntax investigates how the arrangement of built spaces relative to each other produces strong urban environments. Space/Nature Syntax expands upon this understanding of the arrangement of built spaces to other built spaces, to create a "set of rules" for successful built environments which consider their relationship to the natural environment.

Space Syntax was used in this research to analyse 15 public spaces at Arcosanti in order to determine which, according to spatial configuration, should be the most and least likely to exhibit certain types of social interaction. This research uses the *Real Relative Asymmetry (RRA) value* which indicates how accessible a space is from all other spaces at Arcosanti. The lower the RRA value the more connected a space is, with values of 0.4–0.6 generally given to indicate very strong connection: these would be spaces which have strong and easy physical access to a high number of other spaces (Bafna 2003).

The **Nature Syntax** component of the methodology was developed through the research that this paper draws upon and produces the statistical measure *Visibility of Nature (VN) value*. The VN value represents the amount of natural environment visible from within a built space and is a single number between 0 and 1, with 1 being the maximum visual relationship to Nature possible. The VN value is reached by calculating the *Permeability (P value)* of the envelope of a space, and the *Naturalness of View (NoV value)* of what is visible through that permeable area, using the following equation:

$$VN = P \times NoV$$

Next, there were 300 **Interaction Observations** carried out at Arcosanti between February 2015 and February 2016 which established how people interacted with the spaces themselves, and other people within the space. The methodology for the observations was developed by conducting a review of observation techniques used in similar studies (Coley et al. 1997; Cooper-Marcus and Francis 1997; Goličnik 2007; Goličnik and Thompson 2010; Peschardt et al. 2012). All public spaces were observed for 30 min per observation, and four times in each of the following time frames, resulting in 20 observations per public space:

- 0600–0900
- 0900–1200
- 1200–1500
- 1500–1800
- 1800–2100.

Interactions were marked onto a prepared plan of the space using a prepared key with 4 categories of interactions being recorded: *Interaction with Space*; *Interaction with Others*; *Use of Space;* and *Visual Interaction with the Natural Environment (V.I.N.E.)* (Fig. 4).

Interaction with Space considered how a person was using the space, and was recorded as either *Active* or *Passive* with Active being an activity for which the space was being used, and which occurred in the space for more than 30 s, and Passive describing when the space was merely used as a through-route without interaction with any of its features.

Interaction with Others considered how a person interacted with other people within the same space, and used Hall's Proxemics (Fig. 3). Proxemics describes social interactions in terms of the distance a person places between themselves and others. *Intimate interaction* occurs from 0 to 0.5 m and is the distance at which strong emotions—positive and negative—are exchanged; a distance only close family and friends can enter; *Personal interaction* is between 0.5 and 1.2 m, the distance at which most conversation with those we are familiar with occurs; *Social interaction* is the most common distance at between 1.2 and 4 m and is the distance for interaction with acquaintances and colleagues; and *Public interaction* at 4–12 m is the distance one would use to address a group, or to indicate a desire to be alone in a crowd (Hall 1968; Ciolek 1983; Agnus 2012). For this research an additional category of *Alone* was added to indicate when only one person was present in a public space.

Use of Space refers to the degree to which an Interaction with Space was planned prior to its occurrence. There are two criteria within the category; *Intended* and *Spontaneous*. Intended activities were those scheduled or planned for a specific space and time. Spontaneous activities were those which were occurring without planning or direction from anybody other than those carrying out the activity. It was possible to determine whether an activity was Intended or Spontaneous due to daily

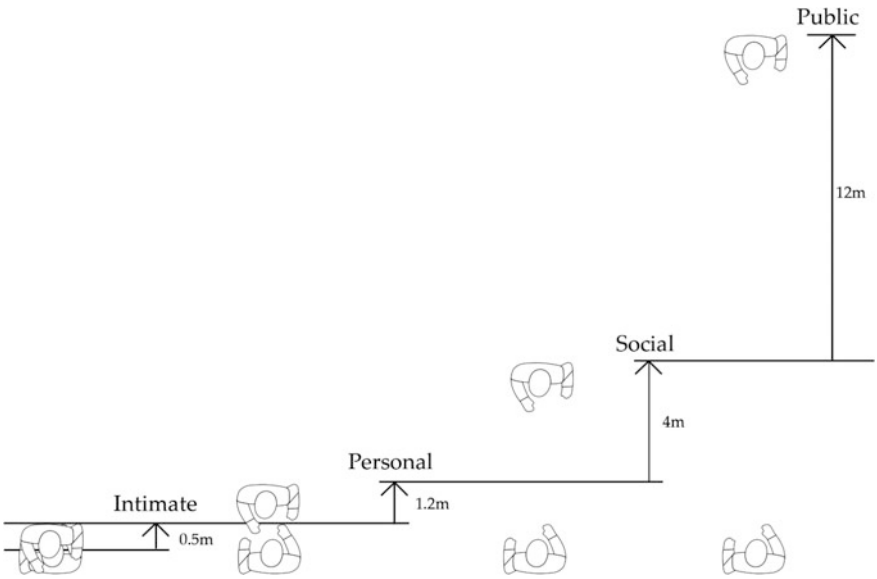


Fig. 3 Diagram of Proxemic distances. *Source* Author

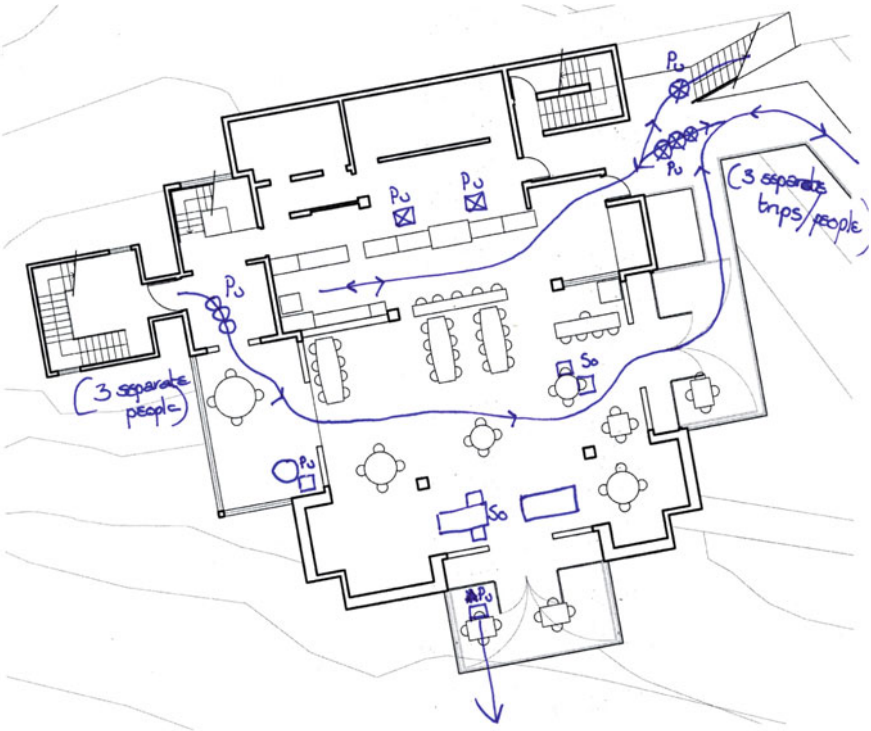
public meetings at Arcosanti where such Intended activities were announced, or by reference to a community notice board which summarised these Intended activities.

The observations also noted any *Visual Interactions with the Natural Environment (V.I.N.E.)* which were occurrences of people displaying behaviour which facilitated viewing the natural environment. Examples of this behaviour included looking out of a window; a person positioning their body and line of sight towards the natural environment; people pointing out features of the natural landscape to other people; people drawing or photographing the natural views (Fig. 4).

Finally there were statistical **Correlations** drawn between the numerical results of the Space Syntax, Nature Syntax, and Observations which showed where there were statistically significant relationships between components. The correlations used *Spearman's rho* (ρ); ± 1 indicated a perfect correlation while 0 indicated no correlation at all: a significance of ≤ 0.1 was termed an S1 significance (weak); a significance of 0.05–0.1 was an S2 significance (moderate); and a ≤ 0.01 an S3 significance (strong).

4 Results from Arcosanti

Table 1 shows the Space Syntax results for the 15 public spaces at Arcosanti, with the Vaults being the most spatially connected (RRA = 0.7523) and Office being the least (RRA = 1.5707). Figure 5 shows the location of all 15 social spaces: they are



Observation Log and Key

Space	CAFE		
Time 5/2/16	Notes (e.g. special event)		
0600-0900			
0900-1200			
1200-1500			
1500-1800 ✓			
1800-2100			
Weather and Temperature (-C)			
SUNNY, WINDY, 8°C			

Interaction Key			Symbol
Interaction with Space, Use of Space	Active	Intended	☒
		Spontaneous	☐
	Passive (and route)	Intended	⊗
		Spontaneous	○
Interaction with Others	Alone		A
	Intimate		In
	Personal		Pe
	Social		So
	Public		Pu
	VINE		→

Fig. 4 Example of completed observation worksheet

distributed across 5 levels, with Level 0 being the ground level. Table 2 shows the Nature Syntax results: the East Crescent roof had the highest visual connection to Nature (VN = 0.64) and the Community Room and Library/Recreation Room both had no visual connection to Nature at all. Table 3 then shows where statistically significant correlations were found across all measured components. There are clearly many points for discussion, but as this paper is interested in how the

Space/Nature Syntax can inform design to facilitate social interaction it will focus on where the results are revealing influences on certain types of social interaction at Arcosanti.

At this point it must be emphasised that correlations indicate only a statistical relationship between components, and not a "cause-and-effect" relationship: the psychological element to be subsequently discussed would give insight on why the relationships exist. There was an S3 correlation between RRA and both Passive Interaction with Space and Spontaneous Use of Space ($\rho = -0.617$ and $\rho = -0.623$ respectively).[1] There was also an S3 correlation between Passive and Spontaneous, with a near-perfect $\rho = 0.963$, indicating that Passive Interaction is highly likely to be unplanned.

Interestingly, there was also an S2 correlation between RRA and Intimate Interaction with Others ($\rho = -0.565$). This indicates that Intimate Interaction is more likely to occur in spaces which are spatially central and experience a high level of movement of people: through-routes. This is surprising, as it was previously indicated that Intimate Interaction is considered the most private of Interactions therefore it would have been expected that this correlation was negative. Intimate Interaction was also correlated with VN ($\rho = 0.508$, S2 strength), indicating that spaces with high visibility of Nature are more likely to see Intimate Interaction. The VN value also, unsurprisingly, returned a correlation with V.I.N.E. ($\rho = 0.494$, S1) indicating that public spaces with high visual connection to the natural environment were more likely to witness people making use of this connection.

In addition to the Interactions returning statistically significant correlations with RRA and VN, there were also interesting correlations among the Interactions themselves which indicates where certain Interactions compliment or discourage each other. The near perfect correlation between Passive and Spontaneous has already been discussed: there were also positive correlations between Active and Passive Interaction with Space ($\rho = 0.533$, S2), and Intended and Spontaneous Use of Space ($\rho = 0.444$, S1). Both these correlations were surprising as they are each other's opposites, in a manner of speaking, therefore any correlation between them would have been expected to be negative. However the positive correlation indicates that a space that is likely to be used in an Active and Intended manner would also be likely to be used in a Passive and Spontaneous manner, suggesting that these opposites are actually encouraging each other.

The only Interaction which returned negative correlations with other Interactions was Alone, which negatively correlated to both Personal and Social Interactions with Others ($\rho = -0.471$, S1 and $\rho = -0.442$, S1 respectively). This suggests that when people are using a space Alone it serves as a deterrent for others to enter that

[1]The RRA value is an inversed value: as spatial connectivity improves, the RRA value reduces numerically. Therefore the negative correlation here indicates that as RRA decreases (and thus spatial connectivity increases) Passive Interaction increases. This should be noted throughout the paper: a negative correlation with the RRA value actually indicates an increase in both factors being discussed.

Table 1 Space syntax results

Public space		TD	MD	C	RA	RRA	IV
14	Vaults	1125	5.0	0.17	0.0354	0.7523	1.3292
6	Community room	1161	5.1	0.20	0.0368	0.7824	1.2780
8	Library/Rec room	1367	6.0	0.50	0.0449	0.9548	1.0473
1	Amphitheatre seating	1403	6.2	0.17	0.0463	0.9850	1.0153
4	Ceramics	1519	6.7	0.33	0.0509	1.0820	0.9242
13	Sky theatre	1522	6.7	0.50	0.0510	1.0845	0.9220
15	Vaults roof	1580	7.0	0.50	0.0533	1.1331	0.8826
12	Roof patio	1587	7.0	0.33	0.0535	1.1389	0.8780
2	Amphitheatre stage	1664	7.4	0.20	0.0566	1.2034	0.8310
3	Cafe	1676	7.4	0.20	0.0570	1.2134	0.8241
9	Music centre	1684	7.5	0.33	0.0573	1.2201	0.8196
7	East crescent roof	1771	7.8	1.00	0.0608	1.2929	0.7734
5	Classroom	1828	8.1	1.00	0.0630	1.3406	0.7459
11	Red room	2063	9.1	0.33	0.0723	1.5373	0.6505
10	Office	2103	9.3	0.25	0.0738	1.5707	0.6366
Mean		1604	7.1	0.40	0.0542	1.1528	0.9039
Median		1587	7.0	0.33	0.0535	1.1389	0.8780

space. Similarly, it could be that people who seek to be Alone do not enter spaces that are already being used by other people. While it is not possible to definitively say which of these is more accurate, both speak to the issue of privacy and an acknowledgement of the need for it at Arcosanti.

Finally, Personal was the only Interaction to have a statistically significant correlation to V.I.N.E. ($\rho = 0.492$, S1), indicating that people who are enjoying the visual relationship to the natural environment from within a built space are more likely to be doing so with people they are comfortable interacting at the Personal distance with, shedding insight on the relationships between people who participate in this activity together at Arcosanti.

4.1 Informing Design Through the Space/Nature Syntax

By establishing the statistically significant correlations it was possible to explore how future alterations to spatial configuration and visibility of Nature at Arcosanti could alter existing patterns of social interaction. Figure 6 shows a future stage of planned construction at Arcosanti named in this research as Phase 3, with significant expansion to the west and south. This construction would significantly change RRA and VN values: Tables 4 and 5 show these values if the construction was completed as planned.

Fig. 5 Location on site of Arcosanti's 15 public spaces

Table 2 Nature syntax results

Public space		P	NoV	VN
7	East crescent roof	0.92	0.59	**0.54**
15	Vaults roof	1.00	0.49	**0.49**
13	Sky theatre	0.96	0.3S	**0.36**
12	Roof patio	0.92	0.40	**0.36**
4	Ceramics	0.63	0.34	**0.21**
1	Amphitheatre seating	1.00	0.20	**0.20**
14	Vaults	0.47	0.36	**0.17**
2	Amphitheatre stage	0.54	0.20	**0.11**
3	Cafe	0.20	0.45	**0.09**
9	Music centre	0.23	0.36	**0.08**
11	Red room	0.16	0.38	**0.06**
10	Office	0.14	0.42	**0.06**
5	Classroom	0.12	0.12	**0.01**
6	Community room	0.11	0.00	**0.00**
8	Library/Rec room	0.00	0.00	**0.00**
Mean		0.49	0.31	**0.18**
Median		0.47	0.36	**0.11**

Figure 7 shows the changes in the distribution of Intimate interaction across Arcosanti's public spaces, and how it could change as a result of the proposed construction. Currently on the site 28.2% of all Intimate interaction is observed in the Vaults. However, as Intimate Interaction was correlated to both RRA and VN and as both would reduce in the Vaults, this share would reduce to 7.7%, a reduction of over 20%. Meanwhile the share of Intimate Interaction in the Cafe increases as its RRA increases: previously it had no Intimate Interaction at all but is projected to have 9.2% of total due to this space becoming a "gateway" to the new construction on the west of the site.

Projected values such as these, derived from statistically significant correlations, could be used to analyse the potential impact of design proposals on social interaction. If the function or atmosphere of a public space was such that a high increase in Passive Interaction, Spontaneous Use, or Intimate Interaction were desired, designers could alter the placement of new construction to increase the spatial centrality of that public space; or they could increase the permeability of the façade through opening size and placement, in a direction where a more natural view lies beyond, if they wished to further increase Intimate interaction. By understanding the indicators of what influences certain types of social interaction, and through understanding that the spatial configuration is not always the sole or strongest influencing factor, public space planners can make informed design decisions to provide spaces that truly meet the spectrum of human social needs.

Table 3 Correlations

		RRA	VN	Active	Passive	Alone	Intimate	Personal	Social	Public	Intended	Spontaneous	V.I.N.E
Spatial connectivity	RRA	1.000											
Visual connectivity to nature	VN	−0.064	1.000										
Interaction with space	Active	−0.129	0.052	1.000									
	Passive	**−0.617*****	−0.112	**0.533****	1.000								
	Alone	0.052	−0.226	−0.376	−0.022	1.000							
	Intimate	**−0.565****	**0.508****	0.432	0.279	−0.107	1.000						
Interaction with others	Personal	−0.292	0.180	**0.795*****	0.334	**−0.471***	**0.514****	1.000					
	Social	−0.295	−0.024	**0.934*****	**0.654*****	**−0.442***	0.418	**0.792*****	1.000				
	Public	0.122	−0.562	**0.723*****	0.252	−0.251	0.070	0.372	**0.643*****	1.000			
Use of space	Intended	−0.186	−0.079	**0.960*****	**0.574****	−0.342	0.391	**0.799*****	**0.897*****	**0.671*****	1.000		
	Spontaneous	**−0.623*****	0.012	0.436	**0.963*****	0.005	0.296	0.282	**0.562****	0.142	**0.444***	1.000	
Visual interaction with the natural environment		0.083	**0.494***	0.217	−0.076	−0.404	0.105	**0.492***	0.157	−0.006	0.187	−0.062	1.000

* $p < 0.1$
** $p < 0.05$
*** $p < 0.01$

Fig. 6 Arcosanti site plan following future proposed construction

Table 4 Space syntax results following proposed construction

Public space		TD	MD	C	RA	RRA	IV
4	Ceramics	5298	6.5	0.33	0.0136	0.5032	1.9871
6	Community room	6015	7.4	0.20	0.0158	0.5837	1.7132
3	Cafe	6074	7.5	0.20	0.0159	0.5903	1.6940
15	Vault roof	6574	8.1	0.50	0.0175	0.6464	1.5470
12	Roof patio	7454	9.2	0.33	0.0201	0.7452	1.3420
14	Vaults	7525	9.3	0.17	0.0203	0.7531	1.3278
8	Library/Rec room	7721	9.5	0.50	0.0209	0.7751	1.2901
9	Music centre	8341	10.3	0.33	0.0228	0.8447	1.1839
2	Amphitheatre stage	8796	10.8	0.20	0.0242	0.8957	1.1164
13	Sky theatre	9029	11.1	0.50	0.0249	0.9219	1.0847
1	Amphitheatre seating	9134	11.2	0.17	0.0252	0.9337	1.0710
11	Red room	10,168	12.5	0.33	0.0283	1.0497	0.9527
10	Office	11,026	13.6	0.25	0.0309	1.1460	0.8726
5	Classroom	11,326	13.9	1.00	0.0319	1.1796	0.8477
7	East crescent roof[a]	n/a	n/a	n/a	n/a	n/a	n/a
Mean		8271	10.2	0.37	0.0226	0.8369	1.2697
Median		8341	10.3	0.33	0.0228	0.8447	1.1839

[a]Existing public space removed by construction

Table 5 Nature Syntax Results following proposed construction

Public space		P	NoV	VN
15	Vaults roof	1.00	0.49	**0.49**
13	Sky theatre	0.96	0.35	**0.34**
12	Roof patio	0.92	0.36	**0.33**
14	Vaults	0.47	0.30	**0.14**
4	Ceramics	0.63	0.20	**0.13**
3	Cafe	0.20	0.42	**0.08**
10	Office	0.14	0.30	**0.04**
11	Red room	0.16	0.25	**0.04**
5	Classroom	0.12	0.12	**0.01**
1	Amphitheatre seating	0.80	0.00	**0.00**
2	Amphitheatre stage	0.46	0.00	**0.00**
6	Community room	0.11	0.00	**0.00**
8	Library/Rec room	0.00	0.00	**0.00**
9	Music centre	0.23	0.00	**0.00**
7	East crescent roof[a]	n/a	n/a	**n/a**
Mean		0.43	0.19	**0.11**
Median		0.25	0.20	**0.04**

[a]Existing public space removed by construction

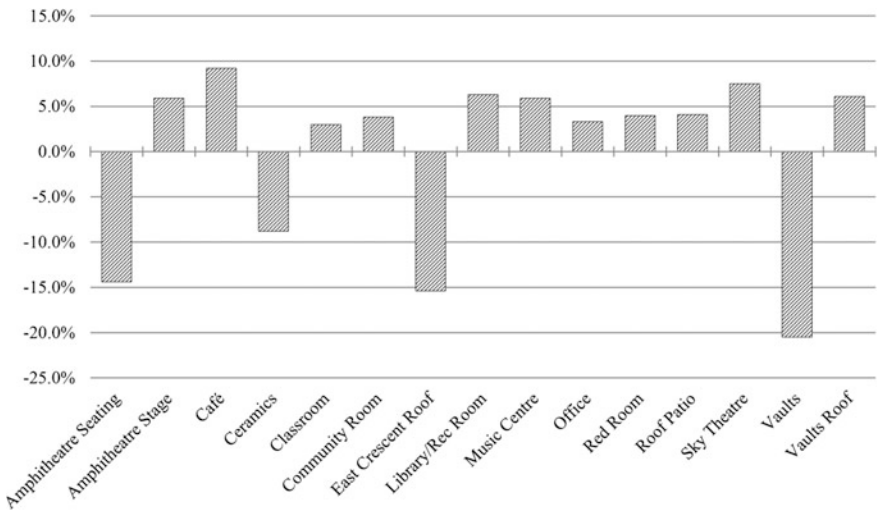


Fig. 7 Projected alterations to distribution of "Intimate" Interaction following proposed construction

5 Discussion

There are some interesting similarities and differences between common observations of how people use public spaces and the results from Arcosanti. The first was the correlation between RRA, and both Passive and Spontaneous. The relationship between spatial connectivity and unplanned, through-route movement in public space has long been recognised: it is both logical and extremely common, and forms some of the most basic principles of Space Syntax studies:

> Let us turn to the factors that make for such places. The most basic one is so obvious it is often overlooked: people. To draw them, a space should tap a strong flow of them. (Whyte 2011 p. 513)

This relationship can also be witnessed at Arcosanti, where the spaces with strong RRA have high Passive and Spontaneous Interaction, as confirmed by the presence of a statistically significant correlation between them. The presence of this most basic relationship between people and space was not unexpected but was useful to evidence, as it speaks to how Arcosanti performs as a built environment, suggesting that even the small dense built environment present there generates the most common patterns of public space use. However what was more unexpected was the correlation between RRA and Intimate Interaction. In the study of Proxemics it is said that Intimate "…is considered improper for the public places" (Agnus 2012). Yet Intimate Interaction was most commonly seen in the most central public spaces at Arcosanti, mirroring the findings of Whyte when studying interactions in public space:

> Lovers are to be found on plazas, but not where you would expect them. When we first started interviewing, people would tell us to be sure to see the lovers in the rear places. But they weren't usually there. They would be out front. (Whyte 2011 p. 513)

There was also a correlation between VN and Intimate Interaction which raises the possibility that this factor, a view of nature, has an influence over social interaction and causes people to behave inversely to social norms, and is more influential than spatial connectivity. While it is not possible to explore this further through statistics alone, it is an interesting point of consideration for the explanation of this common observation, repeatedly stated to go against what one would expect to find.

Another common observation was of Active and Passive Interaction with Space, and Intended and Spontaneous Use of Space being statistically linked. While these Interactions are not complete opposites, it was expected that they would not have a relationship strong enough to result in a statistically significant correlation. However upon reflection on patterns of public space use, it became clear that these are logical correlations. There is a recurring theme that "people attract people" or "Interaction attracts Interaction", with Jacobs, Gehl, and Whyte all observing this fact (Jacobs 2011). Therefore, these relationships further consolidate Arcosanti's public spaces and built environment as performing in a similar way to a traditional built environment.

> Very freely interpreted, a social activity takes place every time two people are together in the same space…The actual meeting, merely being present, is furthermore the seed for other, more comprehensive forms of social activity (Gehl 2011 p. 533)

Despite many commonalities between observed behaviour at Arcosanti and previously observed behaviour in urban environments, there were a few correlations which did not match established patterns. The most significant of these was that Alone negatively correlated to Personal and Social Interactions with Others. This research concluded that, at Arcosanti, people already present in a space partaking in Interactions at the Personal and Social classifications were likely to deter someone who wished to be Alone—or vice versa. This is contrary to what is common in public space literature:

> If you are alone, a lively place can be the best place to be (Whyte 2011 p. 513)

As with the link between Intimate and VN, it is not currently possible to explain why this occurs but it is clear that, at Arcosanti, this relationship between types of Interactions is the inverse of what is commonly observed in public space use.

An interesting relationship which provided to be statistically significant was that between Personal Interaction with Others and V.I.N.E. This correlation suggests the type of relationship between people who were observed displaying signs of V.I.N.E. together. Personal Interaction is the distance at which people interact with close family and friends: this correlation suggests that interaction with Nature is something people at Arcosanti do with people they have this relationship with. This was an interesting finding because of the duality discussed in the Human-Nature relationship studies. Some studies portrayed interaction with Nature as an activity people take part in when they wished to be alone, where other studies found people went to spend time in Nature as more of a social activity. This correlation contributes to this discussion, suggesting that where people are interacting with both other people and Nature at the same time, it is with people that they have a specific close emotional relationship to. Crucially, there was no correlation between Alone and V.I.N.E., suggesting that at Arcosanti at least enjoying a view of Nature is a social activity and not an activity for solitude.

6 Conclusions, Limitations, and Implications for Future Research

As a novel methodology the Space/Nature Syntax naturally experiences some shortcomings. It currently considers only the visual experience of Nature from built spaces. As a methodology which strives to establish the human experience of Nature in urban environments, the Space/Nature Syntax should be developed to consider the entire sensorial range, for example how the sounds, smells and climate associated with Nature are experienced in built space. Secondly, this research is restricted by the use of only one case study in Arcosanti, and would benefit from

repeat studies at different sites to underpin and enhance both the results presented here and the methodology itself. This would allow it to be developed to be fully applicable to traditional urban environments which do not have such extreme access to the natural environment as Arcosanti does. Finally the Space/Nature Syntax would benefit from a component which evaluates the psychological responses of simultaneously experiencing built and natural environments: the work here presents statistically significant relationships on "how" people use space but an element which explores the "why" would clarify and support the findings. This research carried out preliminary work on this and would seek to include the Connectedness to Nature (CtN) methods used in environmental psychology studies.

Despite these limitations the findings of the Space/Nature Syntax at Arcosanti provide a unique insight into how life at the very boundary of built and natural environment impacts people who interact in the public spaces there. This work reveals that both VN and RRA have roles to play in influencing how social interactions occur, and that the two measures may inform different types of social interactions. The projected Interaction figures demonstrate how design proposals could be tested to establish how they could alter relationships between public spaces, relationships to the natural environment, altering how people relate to and interact with others within them. However, it is important to again note that correlations do not show cause-and-effect, merely the existence of a statistical relationship. Thus it cannot be categorically said that, for example, an improvement in RRA definitely causes an increase in Passive Interaction; only that a relationship exists between them. It is imperative that future work supports the statistical data with qualitative evidence as to how spatial connectivity and visibility of Nature affect how people interact.

This work has confirmed patterns such as that between Intimate Interaction and strong spatial connectivity which is common yet counter-intuitive, and set a solid base for further research. Additionally, it has revealed a relationship between Personal Interaction and V.I.N.E. which goes towards clarifying the duality in the relationship between social interaction and the natural environment. While the statistical approach used restricts us from making definitive statements about cause-and-effect, the work has been an essential step; research can now move towards understanding what it is about experiencing spatial and natural connectivity that influences social Interaction.

The Industrial Revolution marked the beginning of an urbanisation that, 200 years later, shows no sign of reversing. Urbanisation is exponential, uncontrollable, and inevitable. The biophilic connection is beneficial, innate, and essential. If the new human landscape is to be urban, then the two must coexist in order for cities to fulfil the biological, emotional, and cognitive needs of humans in addition to the social, political, cultural and economic needs that cities are currently designed to meet. It is through design that the Biophilia connection can be integrated into the urban fabric. But this design must be informed, it must be undertaken with the needs of the human in mind, and must address all of these needs—the biological included. The Space/Nature Syntax takes vital steps towards addressing the need and opportunity to understand how built environments can be designed to nourish humanity's biological need for proximity to Nature.

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Public Policies to Live Well (Buen Vivir) in Harmony with Nature

Vanessa Hasson de Oliveira

Abstract This study covers various disciplines that establish the necessary conversation to demonstrate the interdependence of everyone and everything that live on the planet, and thus, is constituted in its universality. This proposal takes as its core the theory of autopoiesis systems, gravitating around law, quantum physics, theology, philosophy of language and metaphysics, in the search for an element so that, being original and common to everyone, could justify the intent to contribute to a paradigm shift in law and society, abandoning the anthropocentric perspective in favor of affirmative polycentric biopolitics. In that way, it could be possible to achieve enough momentum to overcome the ecological crisis in which the world is currently plagued by. For the successful implementation of these proposals, one needs to recall the invocation of the Law of Universal Fraternity, that prevails regardless of legal enforcement and becomes immanent throughout the entire legal system by the practice of the action of loving—this action being rather natural to everything that is contained in its universality, including the Earth itself under the laws of relativistic quantum physics. Most of all, it includes the perception that love is an expression of how humanity can engage with itself as a person, the community and all other members of the Earth.

Keywords Policies · Health · Welfare · Harmony · Nature

1 Introduction

The greatest expression of this new way of relating exists within the smallest community, the family, which is the basis of a society and thus of the State, whose closest manifestation of each of the related individuals occurs in the cities.

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The environment for the development of such relationships must be prepared and maintained in conditions which provide a way of living in full harmony with nature.

This work intends to demonstrate that for the integral development of the relations between all the members of the nature realized in harmony, the promulgation of public policies in the scope of the municipality and enforcement of the commented ones that foment and promote the execution of projects and activities so that cities could become a healthy-living sustainable environment are essential.

2 The Rights of Nature and the Principle of Harmony with Nature as the Basis of Well-Being Policies in Cities

The theoretical construction of the originating principle of ancestral cultures living in harmony with nature indicates "the expansion of contemporary legal consciousness to the point of recognizing the nature's 'natural' rights" (Guerra, 2016).

The expansion of human consciousness, in fact, must be amplified, with the support of metaphilosophy and (myth) poetics, in order to reinforce the construction of the thesis we are following, along with other authors (Oliveira, 2016), that the Community previously considered only in its human part, in reality comprises all other animate beings and even seemingly lifeless things. The Earth itself and the earth, is an example of this seemingly lifeless things. The earth is made up of a high percentage of living microorganisms and thus is acknowledged as endowed with life. The Earth is acknowledged also as "Mother" by the original ancestral communities, Mother Earth, Pachamama or Pacha Mama.

Human Rights can be defined in the perspective of the Theory of Social Systems Autopoietic, a unifying theory of transdisciplinary paradigm which includes not only the emotion and spirit of the human being, but also the "earth energy" from Earth's riches and the spirit of the very Pachamama. It is a medium privileged by its multidimensional characteristic, admitting all the dimensions of the so-called social partial systems, all endowed with their respective gravitational centers around life, and involved by the environment that governs life, and thus capable of articulating, even with the natural systems, everything that concerns the maintenance of planetary life.

The international community is still concerned with ensuring the efficacy of human rights in respect to human dignity and freedom, because its basis is not sufficient for the resumption of a lifestyle in harmony with the "whole." Thus, it needs to be expanded multidimensionally and holistically to include the whole community, which is the only device of the Declaration of Human Rights (1948) that states at the same time, a duty for man: *"Article 29. 1. Everyone has duties to the community in which alone the free and full development of his personality is possible."*

From the liberating concept of human freedom—freedom means to be aware of coexistence—(Castanhato, 2016), we seek to enter it as a theory myth-poetic and

expand it further to make it multidimensional according to the cosmovision of original indigenous communities. To do so, it is necessary to advocate that its exercise should take place through community integration, replacing the still restrictive view towards the common good of the collective. It is about substituting the exercise of freedom with respect to the other for a full and significant fullness of the exercise of freedom integrated with the relation between all members of the planetary community to make the necessary turn to the rescue of the (myth) poietic or original magic present in the DNA of every creation of Mother Earth, including human beings, to whom are attributed the exercise of the principles of law and its intrinsic values, integrating our beliefs, powers, knowledge, creations and loves that western modernity has guided in its segregation.

Fear of the end falls within this category of segregated value. A physical body that no longer recognizes and does not relate to its immaterial complementarity, its mind, emotions and its spirit. Even in the light of the ignorance of its own multidimensional identity, it ignores and rejects, even violently, the community of which its a part of, and which constitutes it, as it were, material, rational and not relational, alone, representing the end itself.

Maturana and Varela (1995) and Esposito (2007) all confirm that the concept of community is not something that belongs exclusively to the human species. The social behavior that defines it while existing in community also defines the first social insects. The substantial difference is that possibility of dissolution from the community which it originates, seems to be exactly the slightest awareness of their individuality, whose usefulness is not complete if is not used while being part of a community.

From this comes the notion of its transience in this world, losing itself in the emptiness of its individualistic existence and the root memory of being in community, that allows it to be aware of the beautiful notion of 'being' in this world and before it, as the rapprochement of the possibility of being that only exists in the nothingness of death. In this sense, Esposito (2007) proposes: "*if the community belonged to us as our own root, we could—more than that, we must—find it, or reproduce it, according to its original essence.*" While the human community does not find its ancestral original essence, the individuals remain looking for ways to justify their segregation of this *communitas* facing the illusory danger of the death and then losing itself from the planetary community in which we share our destiny and origin. Then, the individual creates escape mechanisms and moves away from this death destiny community, by means of sacrificial mechanisms, which in René Girard's theory, are permeated with violence; considering, even law, one of its forms.

Georges Bataille, in Esposito (2007), points out the time when the individual definitely breaks this institutionalized paradigm of modernity: "*Suddenly appears here the relationship between the community and the death that munus carried within himself from the beginning as its burning and inaccessible core. It is not being an individual of the relationship. The continuum from which we came, and to which we are drawn, a force directly opposed to the survival instinct. The wound we inflict—or from which we emerge—at the same time relating not only to the other, but to the other, of the other, also caught in the same irresistible*

expropriated impulse. This encounter, this chance, this contagion, more intense than any immune cord is the community—of those who, of course, only have it losing it and losing itself in the same flow."

A way to live more as fully human, and thus more humanized, is revealed in living and living in community in an integrated and relational way with all the other animate beings and even the supposed inanimate ones, of this reality called Earth, including itself as being, like Gaia.

2.1 The Perspective from Spirituality

The common home of the ecological community has recently been reformulated in its concepts in the Encyclical Letter of Pope Francis (Francisco, 2013). The direction to take possession Earth ordained by God is now explained in the letter of Francisco, as it refers to taking possession of what is common to be cared for on behalf of the ecological community. It means taking possession of the responsibility that one has. This is the integral Theo-ecology of Pope Francis who preaches the revival of an ecological community.

If before Christian religious culturalism served as an excuse for the usurpation of the earth, to commit atrocities against the members of the original ancestral communities and to the establishment of a culture of individualism and segregation, even of God; now, through the common sense of the ecclesial community of the Church of Francis, we can finally free ourselves from the centuries-old consequences of imposing a misinterpretation of the divine Christian message through the irreducible integration of all beings, families, communities, cultures and spiritualities, to finally admit our holistic unity, the interdependence of our individuality.

Human rights in their multidimensionality, therefore, must include, in addition to the multidiversity of Earth's relational beings, the nature of ancestral cosmovision which considers the multiverse in which the community is inserted and all its coexistence and (co)create reciprocally.

Boff (2015) resumes deep ecology and the applied theory of Ecopsychology to defend, as a crucial vector of human rights, the rights of the heart, in the sense of the drives that must take on the multidiverse relations in the human community, based on a reason originated in thought performed by the "heart." We must rethink the law, human rights—previously conceived based on scientific rationalism—with the heart, a way of thinking that is only possible from the rescue of the natural identity originated by the human being.

Unless there is a wide and deep replacement of anthropocentric paradigm that was the basis of construction of Human Rights, by a non-anthropocentric paradigm, to some authors 'biocentric,' and to others ecocentric or earth centered, or even polycentric, complex and at the same time unifying, there will not be peace, human dignity nor freedom. Humanity will remain isolated waiting fearfully for its death. The realization of human rights can only be achieved by rescuing a wholesome way of life, which disregards the idea of better living through economic development or

even sustainable development and promotes the goal of remaining in balance and harmony with other beings to care for and to (co)create life. It prioritizes distribution and redistribution to the accumulation of material goods, as it considers and seeks complementarity in all beings, things and energies.

A community established on such bases, of life in fullness, no longer worry about the law in its positive form, since it has as its greatest value the content of the intratext of the juridical norm, where it reveals the community conscience, of a full life based in the respect and in the notion of integration, articulation, complementarity and sensitivity in consideration with life.

Living in harmony is the answer that the right has adopted since the constitutions promulgated from the perspective the new Latin American democratic constitutionalism. The new constitutions of Ecuador (2008), Bolivia (2009) and Mexico City (2017) govern the life of society under the ancestral community paradigm, based on the culture of life, which teaches to live in harmony and balance with the surroundings and named this life to the full as *vivir bien* or *buen vivir* or translated in the original language of the Quechua Nation as "sumak kawsay" or "teko kavi" for the Guarani Nation (Mamani, 2015).

Living well as a core principle of the constitutions of Ecuador and Bolivia, implies a way of life more widely and deeply considered than guaranteed well-being, for example, by invoking the principle of the dignity of the human person, which is the vector of the legal order in various parts of the world, as expressed in the Brazilian Constitution, for example.

Welfare policies are geared towards the idea of development at any cost and have notoriously mattered in the ecological crisis in which we live in—in the way a deep ecology understands it—cannibalizing at one and the same time, human beings, nonhuman beings and the Earth itself—the lap that at the same time shelters us as home and caresses us as a mother.

Well-being policies excel at work and consumption; by the freedom of decision on how much to produce, to work, to consume, to own. The unsustainability of this way of life that eludes society in the perception of the meaning of "being well" is reflected in the individual and socio-cultural crisis of human beings, marked by the highest rates of physical and psychic illness, by an individualistic and competitive community, unfolds and contaminates all other members of this community we call planetary (Oliveira, 2016).

The *Buen Vivir*, on the contrary, presses for a life in full whose agglutinating axis is the life in community with respect to the relationality, the complementarity and the interculturality between all the beings that in their interdependence constitute and belong to the Mother Earth.

The illusory freedom advocated by capitalist policies of "welfare" hurts the community principle of relationality and complementarity. The individualistic posture implies the denial of the other, human or nonhuman, and its harmful consequences.

For Acosta (2016), *buen vivir* depends on a process of constant reconstruction based on a community and in respect to the ancestral worldviews, on a natural knowledge of (co)living in harmony. Maintaining the notion that it is not a

definition of a concept, but a development of policies, which recognize and guarantee community practices of living fully, will, to a substantial extent, stimulate the generation of synergistic of efficiency and sufficiency, which implies revising the concept of efficiency to free it from its capitalist burden tied to the production and permanent accumulation of material goods.

It is evident that the recognition of the Rights of Nature follows, albeit not literally expressed, from the updated theoretical understanding of well-being. It is also concluded that there is no legal protection of nature without the guarantee of a human life in the fullness of complementary relations with the other members of the human community and those of the larger nonhuman planetary community.

2.2 *A New Form of Relationship with Nature Under a Non-anthropocentric Paradigm*

These new non-anthropocentric visions require an updating of the Law. This means that even before an honest recognition that the anthropocentric perspective is doomed to the detriment of its own center (Anthropos), there will be a need for a profound change in public policies based on the primacy of work, free initiative and the misconception of well-being. And experiencing all the perverse consequences, the community can (re)sense and naturally return to "*seeking and building alternatives by popular and marginalized sectors, will have to be built mainly from below and from within, with democratic logics of community rootedness*" (Acosta, 2016).

Indeed, it is not enough for the establishment of this new legal order to take place historically as in the methods of a shallow, almost imposed, democracy initiated by uncompromising representatives, sometimes elected by a disjointed population. It is imperative to be sewn and embroidered by a community policy, supported by the notion of relationality and complementarity, in the interdependence that human beings experience as members of the same local community, both as citizens and as living beings.

The design of this new law, under the thrust of (co)existence in fullness in the political community, is the way to create a legal system that no longer confronts "individual rights of one against another, adding disharmony among all" (Mamani, 2015). The author calls this new legal order of Community Ancestral Legal System; advocates the recognition of the "Relationship Rights," which are in clear hierarchical superiority to others, "*the life of all beings, not only the human being, are very important. Faced with a break in the harmony of the community, what is prioritized are the rights of the community and the need to return to balance. And for this we do not resort to punitive practices, the whole community contributes to the person who has left this balance and harmony return to them, assigning work roles to give back the sensitivity and understanding that life is joint and Need for complementarity and care among all*" (Mamani, 2015).

Mamani, of the Aymara indigenous people, proposes a right based on natural laws; a community system which prioritizes the protection of community rights and all forms of life, as understood by those belonging to all members of the Earth community and not only to the human community. This right prioritizes family and community engagement and actions to restore the balance of relations rather than sanction.

Cities are the environment in which such relations develop, and for that, they must be prepared and maintained in conditions that provide this way of living in full harmony with nature. For the integral and harmonic development of relations among all members of nature, it is essential to enact related public policies that foster and promote the execution of projects and activities so that cities are a healthy and sustainable living environment with respect for diversity, complementarity and engagement among all its human and nonhuman members.

3 The Basis of a Universal Declaration of the Rights of Nature for Harmony in the Relationships Among Members of the Earth Community. Advances in the City of São Paulo, Brazil

The Harmony with Nature is a United Nations initiative that has been developing in the form of dialogue and started in 2009 with the creation of the World Mother Earth Day on April 22nd.

The activities and discussions of the initiative have been welcomed by the General Assembly of the United Nations in some Resolutions, in particular number 67, which recognized the guidelines previously indicated by Rio+20 that the Earth is our home, the need to establish a relationship of harmony with nature and that a holistic and integrated approach is necessary.

This important United Nations movement opens a fundamental space for recognition by the world community of the larger planetary community as a subject of rights, especially when some of its members have already enacted laws that recognize these rights, as is the case of Ecuador, Bolivia, New Zealand, the state of Colorado (USA), and the cities of Mexico City, Pittsburgh and Santa Monica, among others in the United States of America, as well as some sparse legislation and jurisprudence that refers to the rights of nature in India, the United States and local communities in various countries around the world.

All this articulation, already somewhat amplified as part of the annual agenda of the United Nations General Assembly, is strengthened by the preparation of the important document proposed by the Universal Declaration of the Rights of Mother Nature. It was approved by the people participating in the World People's Conference on Climate Change and the Rights of Mother Earth on April 2010 in Bolivia, and later taken to Rio+20 in Brazil.

In 2016, we participated with various experts in Earth Jurisprudence—the name that was consigned by the UN on General Assembly to this transdisciplinary theme—of the conference Harmony with Nature. Its work was definitively received at its last General Assembly held in September 2016, to discuss the referral of a dialogue that could be declared as universal. In transdisciplinary fashion, the result was considered as a basis for the report to the 71st United Nations General Assembly.

In the resolution of the trans-disciplinary dialogue, the United Nations (2016a, b) recognized the importance of introduction of new public policies in our governance systems: "The first step is to include the rights of Nature in our governance systems, not by advancing its interests within the capital system as resources to be exploited, but by recognizing the fundamental legal rights of ecosystems and species to exist, thrive and regenerate. Nature is regarded as the source of basic "Earth rights" and these rights cannot be validly circumscribed or abrogated by human jurisprudence."

In this sense, we have made an amendment to the Statute of the City of São Paulo-PLO 05/2015 (2015a) and also intend to send similar proposals to other legislative bodies of the Federative Republic of Brazil in alignment with the international movements.

The proposal for the city of São Paulo is the insertion of a "180 A" in its Organic Law (1990) so that all the public policies related to the environment consider the natural rights of nature:

"*Art. 180 A - The Municipality will promote the development of environment policies, considering that members of nature have intrinsic rights to life and maintenance of their ecosystem processes in interdependence with the dignified life of citizens, with the goal of achieving sustainability in the city.*"

The Committee on Constitution, Justice and Law of Town Hall of the City of São Paulo, in its Advice nº 2251/2015 (2015b), stressed the importance of the proposal for the city, which is still in progress: "*Protection of the environment is one of today's biggest concerns, especially in the city of São Paulo that is considered one of the most polluted on the planet.*"

The Agenda 2030 for Sustainable Development (2015) pointed out in the preamble of its document that among the key areas that need to be worked on so that their goals are achieved is "Prosperity:" "*We are determined to ensure that all human beings can enjoy prosperous and fulfilling lives and that economic, social and technological progress occurs in harmony with nature.*" And among its objectives, highlights number 12.8 which expressly consigns to promote harmony with nature: "*By 2030, ensure that people everywhere have the relevant information and awareness for sustainable development and lifestyles in harmony with nature.*" And we know that global sustainability goals can no longer be reached without an active role of the cities.

Thus, we continue with the articulation between the research and the legislative organs so that other public policies are approved in the city of São Paulo, which provide the desired way of living and of relating in harmony with nature that is found intrinsic in each individual, and just as so, of its collectivities and of the whole planetary community.

4 Life in Fullness in the Policies of the Brazilian Public Health System

Starting from the reality previously raised regarding the interdependence among all members of the Earth community, it is obvious there is a close and direct correlation between the ecological crisis and the physical, mental, emotional and spiritual human pathologies.

This ecological crisis we experience in postmodern times is intrinsically present in every particle of the system, including those of the human being himself. While the environment is polluted with toxic waste, polluted are also human bodies. If there is water shortage in the world, human bodies even places rich in water are dehydrated. If there is a storm out of place and climatic epoch, a swirl of emotions and disconnected thoughts plagues us every day, sometimes without any immediate explanation.

Contemporary philosophers (Esposito, 2017) correlate the autoimmune mechanisms of human bodies with the deficiency of social and ecological systems. Psychologists, as well, for some decades, have bent over the issue of the relationship between emotions and physical illnesses, or psychosomatic diseases.

In the field of environmental psychology, it is recognized that all beings on Earth, including humans, have a common DNA that harmonizes us in the coexistence within the system. For the Family Constellation Theory, the harmony of the system occurs through natural orders called the orders of love and also justified in the theory of the Biology of Love (Maturana, 1991). Human beings, when moving away from the (co)experience of this original system, disconnect from the natural orders and, thus, from everything that is right and from itself.

For the theory of autopoietic systems, the system has the ability to self-regenerate (autopoiesis) and thus seek ways to stimulate the strengthening of its natural defenses, or more appropriately, to eliminate artificial interventions that prevent the phenomenon of natural healing, as homeopathic medicine and other forms of integrative medicine in relation to the health of the individual human does.

Thus, public policies that inaugurate, promote and strengthen health and sustainability in cities, at the same time, have the power to restore health to their coexistence and the environment that surrounds them and shelters them.

One of the most advanced policies in Brazil (2017), especially in the city of São Paulo, is the recognition and, more recently, the expansion of Integrative Medicine, verified the inefficiency of traditional medicine in the promotion of health.

Integrative Medicine has broadened and deepened traditional medicine, seeking to understand and treat the human being, considering its relationship with nature, its emotional life and its individuality.

The holistic currents of health promotion, referring to Noetic Science, which introduces a rather interesting approach to autoimmune diseases, demonstrate the close relationship between the autoimmune crisis in postmodern society and the chronic diseases of mankind and of all the Earth's systems. The "Holoinformational Noetic Medicine" postulates that "*all autoimmune etiology is a disease of*

consciousness, and therefore, requires a cosmological perspective instead of the current limitations of the brain or biochemistry" (Biasi and Amoroso, 2011).

Even these natural healing mechanisms—or the ones that allow healing to take place naturally—suffer the influence of a postmodern society with its need for socio-political mechanisms of an immune nature and may become (and perhaps should be) institutionalized, including being recognized by law, such as homeopathic medicine, anthroposophy and acupuncture, which were integrated into the Unified Health System-SUS (1990) with the institution of the National Policy on Integrative and Complementary Practices-PNPIC (2006) by Law (Ordinance) nº 971, approved on May 3rd, 2006 and most recently added the practices of meditation, yoga, bio-dance, Reiki and art therapy by Ordinance nº 146 (2017).

It is interesting to note that the justification of the Brazilian Law for the adoption of non-conventional medicines lies in considering the integration of man in all their aspects and means, therefore, based on systems theory. Once again, medicine has been given the basis of a policy that cannot be anything if its not a life policy. In this same line of integrative medicine must walk with society and the planetary community in the pursuit of its existential community's health, integrative, although interdependent.

The polycentric affirmative biopolitics theory of Rights of Nature (Oliveira, 2016), allows us to see through the prism of medicine, a planet carrier of a chronic disease, as the autoimmune diseases and, in this sense, proposes the opening of a policy that is interdisciplinary, takes care of patients with chronic diseases and promotes Earth healing.

The law that establishes the "Care Network Health of People with Chronic Diseases in the Unified Health System (2014) says that chronic diseases, generally have multiple causes, and treatment involves lifestyle changes. This stipulates that the purpose of the "Health Attention Network of People with Chronic Diseases" is to serve the chronically ill in full, with realization of actions, health promotion, protection services, disease prevention, diagnosis, treatment, rehabilitation, harm reduction and health maintenance.

In parallel, the problems of systemic health, human and planetary, is clearly in need of behavioral change, with the objective of integral attention. That is, both the approach to human health, as planetary or environmental health, is a behavioral change in order to adopt a multidimensional focus on prevention, treatment and harm reduction and to constantly maintain balance in the system.

That is because the more you want to artificially extract the possibility of conflict and eliminate pain without facilitating behavioral change, the more this pain and unlearning in the resolution of conflicts through a natural human ability settles and becomes unbearable, causing again an immune intervention that disables the body's natural defenses of the human and planetary community.

Thus, the stimuli or the removal of the obstacles created to allow for the expansion of human consciousness, individually and collectively, mutual help practices, cooperation-centered on dialogue, interreligious dialogue, or in short, the connection forms of man himself through the other, including all other members of the planetary community, is the cure of autoimmune process caused by man when

he decided to move away from another human being and other members of the Earth community, to individuate themselves, culminating in the expelling itself.

This cure is, in fact, the natural process of the autopoietic system, which now is heading towards a new structural coupling. Human beings' interactions in expressions of love with the environment towards the result of (re)coupling are enough for them to be able to restore the harmony with the Earth community. And human being's reintegration in nature is a great way to head towards this return.

The homeopathic drops are contained in the extreme opposite of institutionalization of life experiencing post-modernity. They are available in the rescue of the natural laws that made possible the origin and maintenance of life on Earth and of the Earth, now accessible to humans, which is the only one in this community who really need them, through the expansion of its consciousness of universal love.

5 Conclusions

The proposal expressed on the present work, based on transdisciplinary, that combines psychology, medicine, art and law, is here to seek answers through experimentation of human consciousness expansion's methods, considering their interdependence and connection condition with the other members of Nature and with the Earth itself, for the purpose of strengthening public health policies already implemented and to support the enactment of other proposals. This is in particular to those which relate to a fulfilled life, in the harmonious coexistence between human beings, and between them and other members of Nature within the cities that represents a part, in this great perspective of the universe in this spherical, blue and common home.

It is within the cities that the paradigm shift, from a human-centered view to one that will be centered on Earth and everything it provides and shelters, which can and should be applied.

Thus, we hope to have offered theoretical support so that public policies aimed at well-being, living well, understood as a way of life in harmony with Nature, are created and strengthened in all sectors of the community.

With special attention, and assuming the legitimacy of the municipal entity in the enactment of laws that support this direction, we highlight the desired creation and expansion of green spaces and public equipment in it, where it is possible to develop activities or simply provide true contact with Nature. The provision of treatment centers or the promotion of therapeutic activities by individuals through integrative medicine, which is based on reestablishing the reconnection of human beings to themselves and their natural environment. Last but not least, and without intending to be closed on only those proposals, the introduction of the theme of the Rights of Nature in public education and the commemorative calendar of the city.

To support all these proposals and others that must be further elaborated, it is imperative that the recognition of the Rights of Nature is adopted in a principio-logical way as a vector of environmental protection legislation.

In this sense, the research group of the NGO MAPAS has created a document named Nature's Letter (2017) to comply with public environmental managers, legislators and mayors at the cities of Brazil, which has already been signed by many of them. The Nature's Letter is registered at the Harmony with Nature platform and can be reviewed there and on the MAPAS website. We hope this document can offer the principles to enhance public policies and nurture new ones to promote the "*buen vivir*" in harmony with nature respecting its rights within the cities.

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Health and the Urban: Multiple Threads Interconnecting Health in the City

Marco Akerman, Rosilda Mendes and Francisco de Assis Comarú

Abstract Urban scenarios have been analyzed based on the problems due to the changes that drive the historical transformations of society, such as growing urbanization and impact on morbidity-mortality rates, and in the health status of the population. Such trends point out that becoming ill is closely related to socioeconomic-environmental conditions, and also leads to a series of challenges for defining strategic plans of Multilateral Government Agencies ("Global Agendas"). These "Agendas" have emphasized central themes such as "sustainable development", "urban agenda", "climate change", "urban health", "healthy cities". In the present chapter we analyze the relationship between "health" and "urban" in six Global Agendas: (1) "Transforming Our World: The 2030 Agenda for Sustainable Environment"; (2) "New Urban Agenda"; (3) "Intergovernmental Expert Group on Climate Change"; (4) "Shanghai Consensus on Healthy Cities"; (5) "National healthy cities networks in the WHO European—Promoting health and well-being throughout Europe"; and (6) "Integration of Background Documents for the Strategy and Plan of Action on Urban Health for the Americas". As a result of the analysis, we saw that health emerges in these plans with multiple interfaces such as: health and environment; migration and health; access to health services; local governance; urban planning and policies; violence; poverty and vulnerability; health equity. The six documents analyzed acknowledge the mutual relationship between "health" and "urban", although this understanding is not convergent

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among them. Some consider urban as a health determinant and pursue an evidence base for the interconnection, while others see health as a weak link of a potentially harmful urbanization. There still are many questions on the operational framework that crosses health and urban among the global agendas selected.

Keywords Urban health · Healthy city · Health in the city · Health promotion Equity · Social determination · Global agendas

1 "Conversation" Between Health and Urban

Three researchers were talking about the relationship between "urban" and "health". The urbanist, when referring to the HABITAT III document, "the new urban agenda", said he considered that the concept of "health" was addressed in a positive fashion, not necessarily related to disease. The two other researchers who were public health professionals and "health promotors" appreciated the perspective. The urbanist was not comfortable with the glorification of "healthy", because as an activist of urban struggles, he appreciates public health professionals supporting their arguments with indicators that show the negative aspects of urban life such as respiratory diseases and pollution, psychiatric diseases and removals, traffic-associated deaths and urban (i) mobility; death of youth and lack of urban equipment in city outskirts, etc.

How do "health" and "urban" talk to each other? Does "urban" listen? Does "urban" answer? Does "urban" mistreat "health"? Does "urban" need "health" in order to breath?

Maybe, "urban" is not the problem in itself, but how it is organized and set up. In this sense, "urbanization" and "urbanity" also need to be brought to the conversation between "health" and "urban" as they depict a changing "urban". Urbanization identifies the pace of urban growth, while urbanity indicates the quality of urban development. In fact, health and urban establish their interrelationship in the interconnection between quality, quantity and pace of the urbanization process.

2 How Has the Interrelationship Between "Health" and "Urban" Been Dealt with?

Cities are much more than a mass of people with individual risk factors and healthcare needs. Cities are dynamic, attractive and full of opportunities. Frustrations, conflicts and accidents are also an integral part of these human clusters. In this sense, individuals affect and are affected by cities but the perspective needs to be expanded beyond individual factors given the history of cities and their social, political, economic, cultural, organizational aspects, etc. They influence

greatly how individuals live (McKeown 1976; Donnagelo and Pereira 1979; Laurell 1985; Testa 1985; Breilh and Gandra 1986; WHO 2003; Wilkinson and Marmot 2006; Pridmore et al. 2007; Friel et al. 2011; Prasad et al. 2015).

Therefore, accomplishing the desire and intention to improve health in cities should be supported by approaches that acknowledge the complexity of health and cities (Glouberman et al. 2006; Barten et al. 2007; Vlahov et al. 2007; Rice and Hancock 2016).

It is important to point out that "complexity" is not a condition understood as difficult or complicated to solve, and that the solution of complex problems or scenarios cannot occur by using recipes or general models adjustable to any situation.

It implies that understanding the adoption of approaches that recognize complexity is to use multisector and interdisciplinary methods and tools that allow understanding the history, scenario, socioeconomic roots of problems, peoples' perception and uniqueness of each situation under analysis; in other words, build views and interventions appropriate to each specific situation.

How do you do this given the size of cities and the magnitude of urban problems?

Glouberman et al. (2006) discuss current "dominant approaches, (1) urban health and (2) healthy cities" and proposes a new approach (3) "health in cities".

Regarding the practice of urban health, Vlahov et al. (2004) ask 3 questions: (1) Which specific aspects of cities may have a cause and effect relationship with health?; (2) to what extent are these aspects specific to a city or different among cities?; (3) To what extent are these aspects variable in order to allow interventions that can improve health?

Galea et al. (2005) believe that there still is no unified and consensus theoretical benchmark that integrate the multiple factors that influence the health of the urban population and make a proposal of a benchmark that encompasses: (1) major global and national trends; (2) municipal determinants; and (3) urban life conditions.

Freudenberg et al. (2005), Vlahov et al. (2005) analyze three traditional ways of understanding the impact of cities on health: (1) "*urban health penalty*"—focuses on cities concentrating the poor of a country and exposing them to social and physical environments harmful to their health; y (2) "*urban health sprawl*"—indicates the deleterious effects of urban growth to health and to the environment; (3) "*urban health advantage*"—emphasizes the positive effects that living in cities has on health; and suggest another one (4) "*urban living conditions*" that integrates the three previous ones and emphasizes the conditions of urban life as a primary determinant of health.

Barten et al. (2007) believe that only a multisector and long-term approach is capable of facing health determinants in cities. In this sense, it becomes clear that conceptual and operational landmarks from unisector agendas alone will not be capable of encompassing the complexity of the relationship between "health" and "urban".

Many international agencies have dedicated themselves to discussing and proposing interventions so as to support local and national city development

policies to make them sustainable, in order to minimize environment, economic, social risks, recover quality of life and health, and improve the relationship between individuals and cities.

As Glouberman et al. (2006) have underscored that the prospect of *healthy cities* oriented to the development of cities and to the expansion of collective initiatives such as the development of health promoting and protecting networks is added to the urban health approach, mentioned previously. This agenda fostered by the World Health Organization (WHO) has been, since 1988, a strategy to include the health theme on managers' agenda (Westphal 2000) so "more and better health is produced" in cities.

A brief historic review shows that the *healthy cities* agenda has presented few changes in its theoretical framework throughout its existence. The *healthy cities* ideology has its origin in Canada in the 1980's, and afterwards was adopted by the WHO—European Workshop in 1986. In addition to following the foundations and principles of the Ottawa Charter, 1987, the documents include from the development of concepts taking into account the principles of health promotion, to the development of best practices models and action research and monitoring, spreading experiences, and implementation of support and mutual collaboration networks (WHO 1986). In subsequent decades, there was a significant growth of initiatives around the world.

In Latin America, the *healthy cities* movement was driven by the Pan-American Health Association (PAHO) and by proponents of the public health field, after the Bogotá Declaration (1992) and the Caribbean Charter for Health Promotion (1993), based on the experience obtained in projects developed in Europe, Canada and United States (Meresman et al. 2010). The name *healthy municipalities* instead of *healthy cities*, born in the Canadian and European scenario, is being adopted by Latin American countries, as a function of the differences in the political, economic and cultural context. The fact that several initiatives after the year 2000 adopted the name *healthy communities or healthy territories* should be taken into account, given they are based on the principles and values of the movement, but are used for specific parts of a city. In general, the *healthy cities* projects in Latin America show the importance of developing networks, the need to value local experiences and both their civil society and public institution players; and the importance of integrated and participative management. In this case, the intersectoral approach is an important strategy and a synonym of synergy, of ability to coordinate the different, central, regional and local levels, around objectives oriented toward the improvement in people's quality of life and well-being (Freire et al. 2016).

3 Expanding the Observation Lens on the Relationship Between Health and Urban: A Critical Review

If we accept the challenge proposed by Glouberman et al. (2006) who proposed another approach, surpassing the dominant "urban health" and "healthy cities" approaches, aimed at working "health in cities", we understand that multisector global agendas are part of the relationship between "health" and "urban".

Our intention passes through the announcement that thinking health in cities goes beyond the agendas previously made by WHO. The dialogue with agendas of other multilateral organisms pursuing "threads" that can connect "health" and "urban" is urgent.

Therefore, we will do an exercise on building bridges to expand the discussion on the relationship between health and urban. We will analyze the following global agendas: (1) SDG—UN; (2) New Urban Agenda—HABITAT III; (3) Climate Change—IPCC; (4) Healthy Cities—WHO; (5) Urban Health—PAHO; according to connections between "health" and "urban" by reviewing the following documents: (1) "Transforming Our World: the 2030 Agenda for Sustainable Environment" (UN 2015); (2) "New Urban Agenda" (UN Habitat III 2017); (3) "Intergovernmental Expert Group on Climate Change" (IPCC 2015); (4) Shanghai Consensus on Healthy Cities (WHO 2016) and (5) National healthy cities networks in the WHO European - Promoting health and well-being throughout Europe, (WHO 2015) and (6) Integration of Background Documents for the Strategy and Plan of Action on Urban Health for the Americas (PAHO 2011).

The documents were developed in the past five years and underscore regional and global efforts around the strengthening of the agendas selected based on currentness and comprehensiveness criteria.

The search for the keywords "health" and "urban" in global basic documents for each one of the agendas aimed to describe, analyze from what point of view the relationship is established.

The inter-relation between "health" and "urban" identified in the documents was able to find support in the following aspects: technical (organization/strategic development/planning/assessment), policy (sociopolitical, power struggle, participation, mobilization) ideologic (advocacy), legal (legislations, agreements, rights), values (diversity, solidarity). These aspects could be considered assumptions that created connectors and would lead to a possible theoretical standard to revitalize an inter-relation between health and cities.

4 Analysis of Global Agendas

1. Sustainable Environment

The document "Transforming Our World: the 2030 Agenda for Sustainable Environment" (UN 2015) analyzed here has 35 pages. The word "health" is mentioned 23 times, and "urban", 6 times.

Buss et al. (2014) appreciate the fact that the announcement of "health" in the Objectives of Sustainable Environment (SDG) has been expanded, but alert to the "conceptual fractioning and reduction of its goals" (Buss et al. 2014, p. 2555).

The relations between "health" and "urban", however, are not very frequent in the document, and the following quote underscores that the relationship is interpreted, as mitigation of the negative effects of urban on health, through risk management:

"*We will work with authorities and local communities to renew and plan our cities and human settlements, so as to foster the cohesion of communities and personal safety and encourage innovation and jobs.* ***We will reduce the negative impacts of urban activities and of chemical products harmful to the health (our bold)*** *of humans and of the environment, by including environmentally rational management and safe use of chemical substances, reduction and recycling of waste and more efficient use of water and power*" (UN 2015, p. 9).

In another part the document "Transforming Our World" defends changes in the way healthcare is provided, demanding universal coverage and increase in funding to avoid lack of essential health services and to avoid "*brain drain*" from developing countries to more developed ones.

Both interpretations on the relationship between "health" and "urban" surface in these nine indicators of SDG 3 – Health and Well Being, in which the first six (3.1, 3.2, 3.3, 3.4, 3.5, 3.6) recommend control and prevention of morbidity-mortality of selected diseases. On the other hand, SDG 3.7 and 3.8 focus on the care and funding of the system, while indicator 3.9 approaches the need to mitigate and manage chemical and environmental risks.

Another exercise of connection and bridge between health and the Objectives of Sustainable Environment was carried out by WHO as a tease for the Global Health Promotion Conference held in Shangai at the end of 2016: "Health Promotion in the Sustainable Environment". Seventeen health field themes that speak to the 17 SDG and not only to SDG 3 "health and wellbeing" were suggested (WHO 2016). It can be said the initiative is a precious connection exercise to be explored in the future.

2. New Urban Agenda—Quito 2016

The document signed by hundreds of countries called *New Urban Agenda,* fruit of the 3rd United Nations Conference on Housing and Sustainable Urban Development held in 2016 in Quito, Ecuador presents and reaffirms some old and new threads that connect urban and health.

We traced the document and saw that the word "urban" is mentioned 235 times, while "health", 29 times. The expression urban is mentioned several times

associated with urban population, urban development, mobility, economy, resilience, urban policies, governance, urban space, urban-rural relation, urban planning, urban sustainability, urban spread, urban extension, urban violence prevention, urban strategies and urban centers.

The expression "health", in turn, is associated with "mental health" and "public health", well-being, "health outcomes"), for example, activities associated with cycling and also associated with quality of life.

The New Urban Agenda reaffirms previous commitments to exterminate poverty, including extreme poverty, assuring equal rights and opportunities, socioeconomic and cultural diversity, integration in the urban space, liveability conditions, education, food safety, health and well-being.

Some aspects, sectors and approaches stand out in these relations. Vulnerable groups represented by women, the elderly, children, migrants, indigenous peoples, vulnerable youth, individuals with special needs are made explicit and an emphasis in the sense that efforts to improve health and life status of these groups in cities be promoted.

Food safety in cities comes up very strong, considering the importance of having and valuing fresh and healthy food markets, connected to a production and distribution network catering to urban residents.

The role of ways of generating, distributing and consuming power considered clean or renewable that contribute directly or indirectly to improve standards of urban health is also made explicit.

There is an important highlight to the need to improve quality of homes, improve liveability status and location of homes, considering the most vulnerable groups. Conditions of urban mobility are also mentioned as associated with improvement in health status and well-being of the urban population. There is a special mention to accessibility to urban transportation and mobility systems of the population with special needs.

Equitable access of all groups, especially groups vulnerable to quality urban services and infra-structures is also considered strategic as commitments made by governments, aimed at improvement in health status.

The promotion of quality, safe public spaces that allow a good level of "walkability", protection against intimidation and sexual violence of women and girls, with green areas and availability of sidewalks, walkways, streets, safe and quality bicycle lanes also are highlighted on the New Urban Agenda. The importance of multifunctional squares, seaside areas, gardens and parks for social interaction and human inclusion are underscored.

Through the New Urban Agenda, governments also commit to make efforts to promote open, polyvalent, safe, inclusive, accessible, green and quality public spaces to improve resilience of cities to disasters and to climate change, aiming to r*educe risks of flooding, inundations, draughts, and heatwaves, improving safety, physical and mental health and the environment* (UN_HABITAT 2017, p. 26).

The definition of guidelines, technologies and ways to control air quality according to World Health Organization standards are also considered essential to

promote health in cities. Commitment to reducing greenhouse gas emissions by more energetically efficient and intelligent building projects among other measures is reaffirmed.

The signatories commit to assuring coherence between objectives and sector policy measures, highlighting rural development, the use of land, food safety and nutrition, management of natural resources, water and sanitation, health, environment and energy.

Commitment to preventing real-estate speculation, involuntary removal and transfer processes of vulnerable groups is reaffirmed. In more than one part there is mention to the relation between health in cities and the importance of coordinating policies and sectors that allow coherent and efficient use of natural resources, water and sanitation services, and availability of healthy food, clean and renewable energy, sustainable mobility systems coordinated with urban and territorial planning and of quality public spaces for enjoyment, meetings and dialogues in a right to city prospect.

3. Climate Change

The word "health" was identified 82 times and the word "urban" 74 times in the IPCC 2014 document on climate change.

The first part of the document describes results of the countless computer models taking into account the different climate change scenarios, that appoint to worsening of existing problems and conflicts and potential emergence of new problems. There is mention to the impact that climate change tends to cause on the life of poorer individuals, highlighting areas environmentally vulnerable, such as coasts and areas subject to flooding. The idea that climate change definitely raises concerns as to the worsening of health conditions and urban life is worked on considerably.

On the other hand, the document classifies a set of guidelines and proposals of future paths for adapting, mitigation and sustainable development.

It draws attention to the significant potential co-benefits, synergies and exchanges that exist between mitigation and adaptation. Examples of actions with co-benefits include increase in energy efficiency and sources of "clean" energy; reduction in power and water consumption in urban areas by expanding green areas and water recycling.

The document also draws attention to the importance of investing—even indirectly—in distribution of income, supply of labor and in reduction of urban spreading—all as possible co-benefits of investments in mitigation and actions in energy safety.

It reaffirms, from the lifestyle point of view, behavior, culture in mitigation and adaptation processes. There are specific calls to the importance that spatial planning and use of land, zoning laws, urbanization programs and provision of infra-structure and urban services, economic diversification, local adaptation plans, national and regional adaptation plans, municipal water management and management of coast zone programs tend to have. There is also recommendation as to improvement in the capacity of low income groups and vulnerable communities to deal with

changes, and recommendations for partnerships with local governments that can help in adjustment strategies.

There are also mentions to use appropriate and low impact technologies in the production and renovation of buildings and urban construction, and the option for technological options that reduce air pollution and noise in investments in urban mobility. The expansion of mobility options that increase physical activity, road safety, mobility with equity is recommended. Also recommended are using mixed zoning, avoid low urban densities and, whenever possible, facilitate shortening home-work and home-study distances by planning, managing and controlling use of land, thus reducing competition for urban soil. The document draws attention to the fact that whenever distances and daily travel times are decreased, the dependence on oil and on the volatility of its price decrease, on one hand, and allow the expansion of work productivity associated with decrease in traffic jams and improvement in atmosphere and health conditions, on the other hand.

4. **Urban Health**

The "PAHO Integration of Background Documents for the Strategy and Plan of Action on Urban Health for the Americas, Washington, Pan American Health Organization, 2011" document has 56 pages and the word "health" comes up 669 times, "urban" 406, and "urban health" 144. The analysis concentrates on excerpts in which relations between "health" and "urban" are found.

In this sense, the first inference from this analysis is that URBAN HEALTH is driven by the Pan-American Health Organization (PAHO) as an operational category. A strategy for health intervention in the urban space:

"*Countries will now have the responsibility for, among other things, adopting guidelines, tools and methods to promote social participation and reorientation of health services; adjusting surveillance systems to include determinants and indicators related to urban health as well as to document urban health processes and experiences; promote specific health promotion and sustainable development projects that encourage social participation, intersectoral action and/or access to infrastructure, sanitation, education and health services as well as social subsidies; and to report back every two years on the progress they make*" (PAHO 2011, p. 6).

Also, supporting that inference, there is an Urban Health Action Plan designed with five specific objectives: (1) Develop urban health policies; (2) Adjust urban health services to promote health and improve coverage; (3): Construct health-promoting normative frameworks and participatory governance strategies; (4) Expand national and regional networks for healthy urban development; (5) Strengthen knowledge, capacity, and awareness to respond to emerging urban health challenges. The Plan is part for the first time of a pioneering Regional Urban Health Strategy for the countries of the Americas (PAHO 2011).

The Plan emerges now, but it has been acknowledged that "*there are numerous Governing Body mandates dating back to 1992 that highlight the need to address urban health issues and the inequities in health caused by urbanization in the Region*" (PAHO 2011, p. 9).

"Urbanization" emerges as a category that explains how cities interfere in health, showing its character of a social determinant of health; a fact that had already been announced by the WHO Social Determinants of Health Committee that chose urbanization as one of its nine Knowledge Networks (WHO 2008).

According to the PAHO Agenda (2011, p. 10) "achieving urban health is a multi-sectorial endeavor that involves concerted action to promote physical activity; design safe, effective and accessible public transport options; prevent and reduce injuries; reduce the harmful use of alcohol; and address the particular access and wellness needs of the most vulnerable groups, including children, older persons, and people with special needs".

In this sense, promoting health in the city is pursuing a "*combination of stewardship over the health system and its network of services and with the other social actors in urban settings to advocate and adjust for all manner of urban health services that can address the special needs of the social gradient and the heterogeneity of urban populations*" (PAHO 2011, p. 10). *That is why it is necessary to delineate* "*methods for achieving multi-sectoral action, including health impact assessment, health equity impact assessment, and cross-sector data collection and analysis*" (PAHO 2011, p. 11).

At the times PAHO (2011) suggested a set of questions in order to establish actions that interfere in the relationship between health and cities: (1) How to develop relevant intersectoral initiatives to modify health determinants in urban settings?; (2) How to establish a common objective?; (3) What instruments are required to exercise health sector governance in urban settings?; (4) What are the existing capacities and the capacities that are needed to achieve it?; (5) What role the Ministry of Health's play in planning geared to a healthy future for cities?; (6) How should the health services and other relevant sectors act in managing cities to prevent and control the health risks associated with climate change?

5. **Healthy Cities**

We propose to revisit the agenda for *healthy cities* based on two documents developed recently under the auspices of the WHO. One is the synthesis document of the forum of mayors, named "*Shanghai Consensus on Healthy Cities 2016*", on a recent discussion at the 9th World Health Promotion Conference in Shanghai, China, held in 2016. The other document "*National healthy cities networks in the WHO European—Promoting health and well-being throughout Europe, 2015*" makes the assumptions and guidelines for the implementation of the *healthy cities* network in Europe. When we searched the keyword "urban" in both documents, we observed a trend toward "urban planning", "urban development" and "urban health".

The Shanghai document has 4 pages and mentioned the term "urban" six times, the word "health" appears 33 times and "healthy" was mentioned 9 times. In general, the document acknowledges that health and well-being are part of the Sustainable Development Objectives (SDG) and calls on managers, decision makers to implement good governance platforms to promote health. It reaffirms the

importance of political commitment to health in all domains of city governance in order to measure the impact of local policies on health.

The document also underlines, through five governance principles, that achieving MDO will require a close synergy between global and national goals and local plans and programs (WHO 2016). The principles discussed in the document thesis of the forum are explicit on an expanded view of the *healthy cities* agenda and seem to reaffirm the connection of the different urban policies around the commitment to approach the social, economic and environmental determinants of health. From the method standpoint, they underscore the need to involve all relevant players in urban planning, based on partnerships aimed at implementing policies that reduce poverty and inequality, address rights and social inclusion. One of the central principles of health promotion valued since the Letter of Ottawa, is the reorientation of health and social services toward equity so as to assure access exactly to public services and universal health. Following a trend of public policies in general, there is a highlight to the perspective of assessing *healthy cities* initiatives seeking to build a base of evidence in health promotion. The intention to coordinate the *healthy cities* agenda with that of SDG is clearly presented and toward that end political and local leadership are called on to strengthen the work in city networks (WHO 2016).

The European Healthy Cities Network document that deals with the results of an investigation carried out among 19 countries of the network, has 136 pages. The term "urban" comes up 84 times related to many areas, among which the following stand out: "urban health", "urban areas", "urban environment", "urban planning" and "urban population". The word "health" is mentioned 33 times and the word "healthy", 9 times.

Based on the observation that in the SDG European region, about 65% of individuals live in urban areas a range of determinants that influence directly the production of health is appointed, including the lack of integrated policies, limited human, financial resources, etc.

The WHO/EHCN—WHO European Healthy Cities Network project can be considered the best structured initiative of the *healthy city* agenda and has been implemented in six stages since 1988. The sixth state initiated in the year 2014 is anticipated to be final in 2018 (WHO 2015). The new stage of the European Network Project, Phase VI, explicitly underscores the influence of the urban environment on health and calls on healthy European cities and National healthy city networks to carry out the core themes of Phase VI, based on the local adaptation of Health 2020's four priorities for action:

- *investing in life-course approaches and empowering people*
- *tackling major public health challenges*
- *strengthening people-centered health systems and public health capacity*
- *creating resilient communities and supportive environments* (WHO 2015, p. 10).

It also points out an important aspect to be taken into account: when national networks provide populational data from their domestic statistical services they

have inconsistencies when compared to the 2012 numbers of the United Nations on the population that lives in urban areas, suggesting a difference in the definition of "urban" among countries.

5 Conclusion

Is there any sign of convergence among documents of the agendas? Which threads can we use to interconnect?

The consensus around its objectives in theory should orient international cooperation agendas to become a tool, several times for channeling resources and defining formats and strategies of action.

If, on one hand, these aspects are important internationally to make the debate on subjects such as facing inequities, poverty, injustices and affirmative rights legitimate, on the other hand, they are very general goals, unconnected, frequently from other commitments made at the regional and local levels.

The six documents analyzed acknowledge a mutual relationship between "health" and "urban", but this understanding is not convergent among them, some place urban as a determinant of health, pursuing a base of evidence for this interconnection, while others see health as a fragile link of a potentially harmful urbanization. Many questions on an operational landmark that crosses health and urban among selected global agendas still remain.

We have identified convergences:

- Recommendation to develop public spaces/healthy surroundings.
- Triggering tools and practice of urban planning (master plan, law on the use and occupation of the land, urban management, etc.)
- Identification of co-benefits of investments of a sector, in another sector (for example, in health, facing poverty, inequality, etc.)
- Call for political commitment.

The WHO and PAHO documents strengthen the importance of building a base of evidence in health promotion and expansion in the capacity to measure, assess and monitor.

Some actions may have a "hyper synergic role". For example: social inclusion of low income worker groups near urban centers and near the work/job/study place. It is a type of measure whose consequence can encompass a number of co-benefits: decrease in travel time, less dependence on fossil fuel, less air pollution, less exposure to traffic accidents, higher productivity, more leisure, study, culture and family time, etc.

We know that de development of global agendas is a battle field on development and alternative models at the international level. Therefore, the importance of international cooperation needs to be strengthened not only as a list of "good

intentions", but also as space for dynamic discussion and political reflection that include the dialogue with the several segments of society.

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Making Rural and Urban Connections by Integrating Nutrition and Agriculture: A Case Study of Food and Nutrition Security Instruments in Brazil

Veruska Prado Alexandre, Claudia Job Schmitt and Renato Sérgio Jamil Maluf

Abstract The complex relations connecting food, health, and the environment are at the center stage of contemporary food policy. In the increasingly urbanized world, the metabolic relations linking the cities and the countryside through food, gained visibility as a matter of concern. It turns possible to argue that healthy eating based on sustainable food systems is an important component for linking cities, rural areas, and sustainability. This task is permeated by multiple determinants that requires making use of integrative public policy instruments. The paper discusses two such instruments drawing from the historical construction of a FSN policy agenda in Brazil: The National School Meal Program (NSMP) and the Brazilian Food Guide (BFG). It analyzes how these healthy food and nutrition instruments connect agriculture and nutrition and how they define the relationships with the notion of 'sustainability'. A case study of the BFG and the NSMP was conducted with a qualitative approach, applying the thematic analysis of official documents and normative frameworks. The paper shows that BFG integrative approach of nutrition and agriculture is a result of a broader view articulating environment, food systems, nutrition, and health. Nutrition and agriculture are integrated in the NSMP through connecting food production and food consumption, besides adding two transversal elements: territory as reference for local development actions; building

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knowledge based on food and nutrition education strategies. Nonetheless, the two public programs are precursors of a tendency of reconnecting urban and rural areas while arguing for sustainable food systems.

Keywords Nutrition · Agriculture · Food and Nutrition Security
Public Policies

1 Introduction

The complex relations connecting food, health and the environment are at the center stage of contemporary food policy. The productionist framework that oriented the policy agenda after World War II, structured around the axis *agricultural productivity—food availability*, was challenged in the past few decades by a series of emerging issues, actors and events that produced important shifts in public debate. Rising inequalities, new perceptions related to food quality and food risks, along with the increasing recognition of the current ecological crisis, helped to draw political and public attention to the contradictions of the intensive food regime. In a world with 54.5% of the population living in urban areas,[1] the metabolic relations linking the cities and the countryside through food, gained visibility as a matter of concern. In this changing scenario, it is possible to observe, at the same time, a reconfiguration of the "food question". The struggle against hunger, as an objective of public policy, is no longer the only challenge to be overcome, dividing space with a series of problems associated to nutritional deficiencies and over-consumption. It turns possible to argue that sustainable cities include connecting human health and environment through achieving 'sustainable diets' (Mason and Lang 2017), require structural changes in the current agri-food system and build new alliances between food consumers and producers, urban centers and their surrounding countryside (Marsden and Sonnino 2012).

In this regard, the effort to promote healthy eating and nutrition through public policy is permeated by multiple determinants that can only be addressed through intersectoral public actions. The role of state and non-state actors is a crucial element in the policy process. Over the last 20 years, Brazil has established a set of public actions that targets food and nutrition based approaches on the theoretical and practical field of Food and Nutrition Security (FNS) on dialogues with social demands (Leão and Maluf 2012).

The development of Brazil's FNS policies and programs was strongly influenced by civil society's political mobilization at the forefront of the struggle for social rights, along with the loopholes opened by the 1988 Constitution with regard to the

[1]According to the United Nations World Urbanization Prospects, 3.9 billion people lived in urban areas, worldwide, by 2014. United Nations estimates, continuing population growth and urbanization are projected to add 2.5 billion people to the world's urban population by 2050. Available at: https://esa.un.org/unpd/wup/publications/files/wup2014-highlights.Pdf. Access: 02/06/2017.

institutionalization of mechanisms of social participation. In an environment of expansion of democratic freedoms, the resumption of public debate on the role of the State in meeting social demands helped to make some governmental institutions more permeable to intersectoral approaches to policy action (Burlandy 2009; Leão and Maluf 2012).

The roots of the construction at national level of a network of social organizations and engaged policy makers committed to the promotion of FNS can be found in the process of social mobilization oriented towards the defense of ethics, citizenship and the struggle against hunger that occurred in the 1980s during Brazil's democratization process (Spitz et al. 2008). This struggle was eventually incorporated into the deliberations of the 1st National Conference on Food and Nutrition (CNAN) held in 1986, as part of the National Conference on Health. Some of the outcomes of those 1st CNAN deliberations were: the national food and nutrition policy (published in 1997); nutrition was added to the food security debate giving impetus to the Brazilian concept of FNS; and the recommendation to structure the national FNS system (Burlandy 2009).

This first cycle of FNS policy-making (1993–1994) was disrupted, however, in the mid-1990s, by decision of the executive power during Fernando Henrique Cardoso government. This process was only resumed at the national level with the election of Luis Inácio Lula da Silva of the Workers' Party, leader of the coalition government that assumed the presidency of the republic in 2003. In this same year, the new government reorganized the National Council on Food and Nutrition Security (CONSEA), launching, in addition, an intersectoral policy strategy aiming to eradicate hunger and food insecurity in the country. From 2003 to 2016 the formulation and implementation of public policy instruments related to FNS was influenced by different mechanisms of social participation. This new political and institutional setting enabled the involvement of civil society in the construction and monitoring of government programs and actions through the National Conferences on Food and Nutrition Security, the institutionalization of CONSEA and related councils, at state and municipal levels.[2] Between 1994 and 2015, five national FNS conferences were conducted, the most recent being in 2015 under the theme 'Real Food in the Countryside and in the City: for food rights and sovereignty' (CONSEA 2017).

These national FNS conferences provide pluralistic venues where representatives from civil society, governments (federal, state, and municipal), and guests can debate the FNS situation, priorities, and strategic agenda for Brazil. The results of the conference debates and decisions have been guiding CONSEA's actions in the federal, state, and municipal levels of administration, influenced the creation of FNS public policies associated to different government sectors (Costa and Bógus 2012). However, as a result of the political and social changes taking place in Brazil today, marked by economic crisis, unemployment, de-structuring of social

[2]The National Council of Food Security is a consultative body, responsible for advising the Presidency of the Republic in issues related to FNS. It is composed by two-thirds of representatives from civil society and one-third of government representatives.

programs and deep political and institutional instability, conferences should play more fundamental roles in order to prevent further setbacks regarding the progress made in recent decades in social well-being and health and nutrition indicators.

This participatory approach applied to the formulation of FNS policies and actions in Brazil, in conjunction with a government administration plan sensitive to social issues and targeting the reduction of social inequalities, generated opportunities for the creation of innovative policy instruments that connects agriculture, sustainability, food, and the environment. Overcoming hunger, malnutrition, nutritional deficiencies, and diseases associated to food such as chronic noncommunicable diseases (NCDs) for the entire Brazilian population required actions from the health sector and other sectors in order to address the broad set of social determinants of health and nutrition (Dixon 2015; Sundaram et al. 2015; WHO 2013). A number of related intersectoral public policies were mobilized in this task: the *Bolsa Família* program (initiated in 2003) that played an important role in guaranteeing a minimum income for acquiring food, the National Policy of Agroecology and Organic Production (2012a) focused in the development of organic and agroecological food production, contributing, therefore to the sustainable use of natural resources and the supply and consumption of healthy food, and the Framework of Reference for Food and Nutrition Education (2012b) that included education actions at the different phases of the agri-food systems, and others.

Instruments oriented to the promotion of healthy eating and nutrition such as the National School Meal Program (NSMP) and the Brazilian Food Guide (BFG) are an expression of the historical construction of the FNS policy agenda in Brazil. The formulation and implementation of these programs can be considered an important step in the process of capacity building in order to attain healthy eating using an approach that integrates especially education, agriculture, health, social assistance, and environment sectors to achieve their goals. Both are associated to the national FNS policy and follow its principles and guidelines. Furthermore, both instruments are keenly tuned to social demands related to food and nutrition, and address them using an approach centered more on food than on nutrients.

These healthy eating and nutrition policy instruments can also be understood as approaches to connect the food and nutrition dimensions, in that they prioritize food and the restructuring of social and ecological relations connecting production and consumption, agriculture and nutrition, the cities and the countryside.

This chapter seeks to analyze how these healthy food and nutrition instruments connect agriculture and nutrition and how they define the relationships with the notion of 'sustainability'. Our objective is to use them as a basis for illustrating possible Brazilian contributions to the international debate. A case studies of the BFG and the NSMP were conducted with a qualitative approach, applying the thematic analysis (Clarke and Braun 2017). Official documents and normative frameworks were analyzed.

2 Integrating Nutrition and Agriculture in the Brazilian Food Guide

Food guides are instruments for translating nutritional knowledge into practical messages using simple language that considers social, economic, cultural, and environmental factors (FAO 1996).

The BFG is an public instrument that aims to support and encourage healthy eating practices for individuals and collectives, as well as a guide for policies, actions, and programs that promote health, FNS, and well-being for the Brazilian people (Brasil 2014, Monteiro et al. 2015). It was built for use in different settings such as schools, health facilities, homes as well as by different workers connected with health care, nongovernmental organizations, and also in different sectors involved at the food systems (Monteiro et al. 2015).

The document describes the guiding principles that underlie the recommendations for people over 2 years of age[3] and the strategies for overcoming obstacles (individual and collective) that stand in the way of healthy eating.

The document refers to establish intersectoral actions that promote adequate and healthy eating and that prioritize food and meals as a way to build a healthy nutritional status (Monteiro et al. 2015). Brazil's FG used the food based approach and a new classification based on processing levels to define the recommendations. This approach has had positive repercussion both nationally and internationally, however, there is some criticism coming from the food studies field regarding the food classification.

The components of the BFG are shown in Fig. 1. In terms of public action planning, the analysis of the Food Guide identified four strategic categories for attaining healthy eating: intersectoral actions, food and nutrition education, multilevel actions, and sustainability (Fig. 1).

Intersectoral actions are understood as the alignment of intervention and research strategies implemented by actors associated to two or more public sectors that share objectives, values, and actions (Potvin 2012). It is a commonly concept on the theoretical and practical field of health promotion that corresponds to establish partnerships between different sectors in order to meet a common goal. In the BFG, intersectoral action is considered fundamental to addressing the social determinants of health and for promoting the healthy eating practices. The fact that different sectors can contribute in this type of action has led to reflections on possible conflicts of interest occurring in integrated actions between public and private sectors (Gomes 2015; Burlandy et al. 2016).

The food and nutrition education is a strategy turned to build capabilities and abilities for an adequate and healthy eating through the debate about the nutrients, food, and food systems. This helps establish links between food consumption and

[3]In cases of sickness the recommendations must be adapted to treatment requirements. Brazil has a food guide for children under the age of 2.

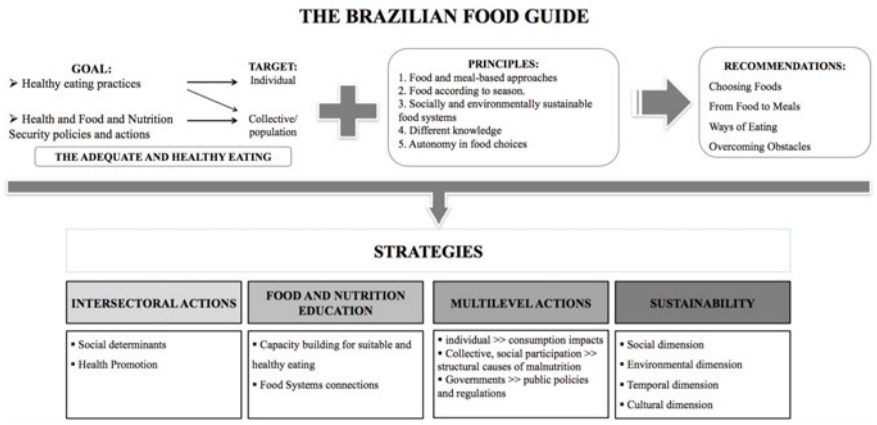

Fig. 1 Components of the Brazilian food guide and planning strategies for public actions. *Source* Build by Brazil (2014)

food production that can encourage people to adopt food practices that promote health and that are socially and environmentally sustainable.

The BFG proposes actions at different levels of governance, which are categorized as 'multilevel actions': individual, collective, and governmental levels. The individual level describes the association between the food consumption and their impact on production, processing, food prices, preserving or promoting traditional food cultures, and on the environment. The collective level describes the collective actions and social participation as ways to guarantee access to food and to create public policies and regulations that promote adequate and healthy eating. And finally, the governmental level refers to the responsibilities in approving public policies and regulations that promote health and that guarantee the Right to Adequate Food, Food Sovereignty, and FNS for the people.

The sustainability strategy has four dimensions: social, environmental, temporal, and cultural. The intention of these subdivisions is not fragmentation, but rather to highlight the dimensions that formulate the Food Guide's understanding of sustainability. The social dimension is associated to aspects such as: (1) the connection between ways of food production, processing, and distribution, and the promotion of social justice, equity, and autonomy; (2) the Right to Adequate Food dimension; (3) social life and social cohesion that builds and strengthens a sense of belonging. The environmental dimension is based on the relationship between food systems and territories, food origins (animal or plant), type of food (organic or agroecological), and the types and impacts of processing. The temporal dimension emphasizes that today's consumption cannot compromise future generations, which is also described by Monteiro et al. (2015). Finally, the cultural dimension recognizes the need to protect and strengthen traditional food culture.

Our analysis of the approach espoused by the BFG (Brasil 2014) to integrate nutrition and agriculture confirms that its guidelines are based on a cyclical concept

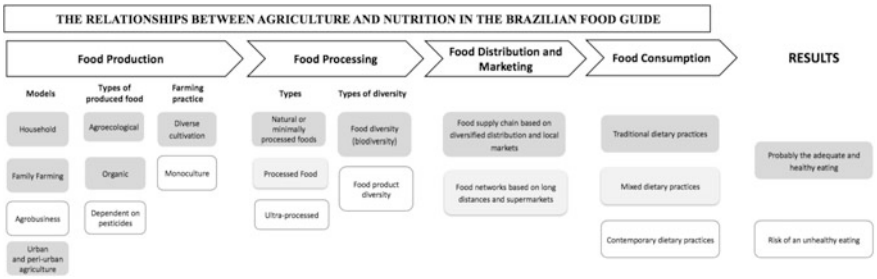

Fig. 2 Categories and subcategories on the integration of nutrition and agriculture in the food guide

that connects the food systems with the nutritional status. This means that the food systems affect the food consumption practices and also that the consumption influences the arrangement of the food systems.

The different connections between food production, processing, distribution and marketing, and consumption according to the BFG are shown at Fig. 2. It emphasizes that the traditional and healthy eating practices are connected with the consumption of natural or minimally processed foods rather than processed and ultra-processed foods. The BFG indicates that traditional food consumption is influenced by (and also influence) the ways of food production, processing, and distribution/marketing. The consumption of food from family farming tends to strengthen the local produce, the organic or agroecological foods production, and to promote the dietary diversity by way of varied food cultivation. The family farming model was also connected with the natural food, minimally processed, or processed with better nutritional value. These types of food are typically integrated within local markets and diverse supply chains. These set of food systems phases contribute (and are strengthened) by traditional eating practices, which individuals can adopt either fully or partially (Fig. 2).

3 Integration of Nutrition and Agriculture in the National School Meal Program

The NSMP is a landmark for public policies that promote healthy eating and FNS in Brazil and the world (Schneider et al. 2010; Rocha et al. 2012; Sidaner et al. 2013). It is identified as a strategy to protect traditional Brazilian diet and food systems, which is key to containing NCDs (Monteiro and Cannon 2012). Furthermore, the NSMP is part of a set of policies that contributed to Brazil being removed from the hunger map of the Food and Agriculture Organization (FAO) of the United Nations in 2014 (FAO 2016).

The NSMP is regulated by Law n. 11.947 of June 2009 (Brasil 2009) and Resolution/CD/FNDE n. 26 of June 2013 (Brasil 2013). This legal framework

expanded the program's actions including food and nutrition education beyond the school food supply (Brasil 2009). Furthermore, this legislation addresses the inclusion of family farmers, indigenous people, and traditional communities as school food suppliers, which prioritizes locally produced foods that are mostly natural or minimally processed, respects local food traditions and cultures, and contributes to rural development (UNSCN 2013; Sidaner et al. 2013). It also provides access to greater food diversity and also a better nutritional value (Soares et al. 2017).

The NSMP aims to promoting the psychosocial growth and development of students, providing support for better academic outcomes, and promoting healthy eating practices (Brasil 2009). The strategies to address these goals include supplying meals and developing food and nutrition education actions (Brasil 2009, 2013). We identified a set of elements that qualify and describe these macro strategies for executing the NSMP (Fig. 3, part 3a). We opted to categorize the elements that make up these macro strategies into five operational strategies (Fig. 3, part 3b).

The analysis allowed us to associate a larger number of descriptors to NSMP's operational strategies: production (6 descriptors), purchasing (5), and consumption (5). The categories 'knowledge' and 'territory' have 2 descriptors each. The 'production' operational strategy has two elements that address ways of producing food (family farming based production), the types of foods produced (organic and/or agroecological, according to the biome and season), and the type of cultivation (diversified). The 'purchasing' strategy links the types of food (basic foodstuffs),

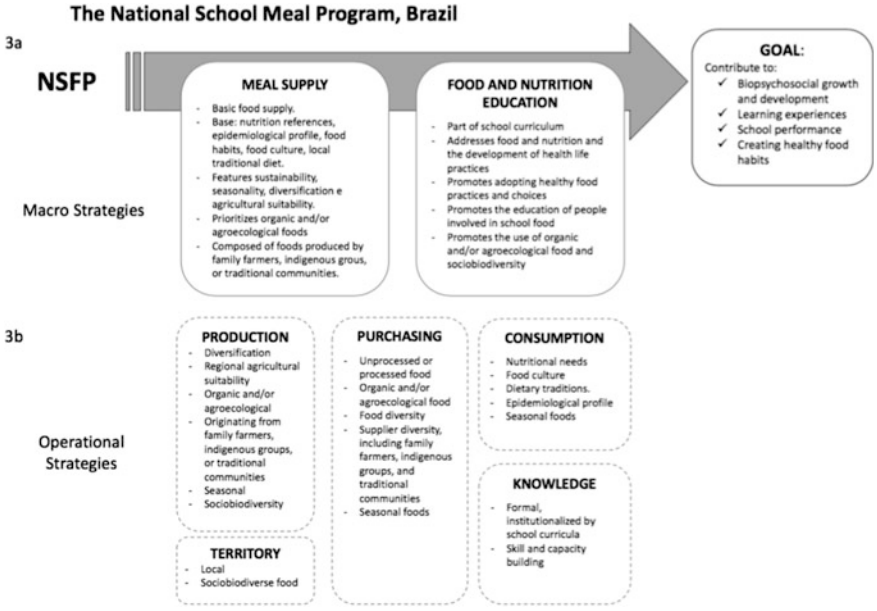

Fig. 3 Macro strategies and operational strategies for addressing the National School Meal Program objectives. *Source* Build by Brazil (Brasil 2009, 2013)

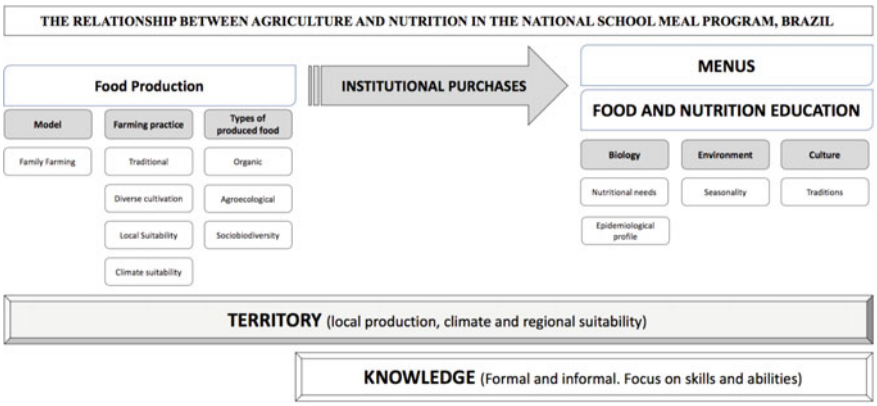

Fig. 4 Set of categories and subcategories related to the integration of nutrition and agriculture identified in the National School Meal Program

types of produced food (organic and/or agroecological), seasons, the variety of foods, and the diversity of suppliers (including indigenous people, family farmers, and traditional communities). Basic foodstuffs are natural, minimally processed, or processed with low sugar, sodium, and fat that fit with the local food culture, agricultural suitability, and seasons (Brasil 2013).

The 'consumption' strategy has three predominant dimensions: biology (nutritional requirements and epidemiological profile), culture and food traditions, and environment (consuming foods that are in season). The 'territory' strategy is made up of elements related to geography and the environment/biome (socio-biodiversity foods). And finally, the 'knowledge' that highlights formal teaching and learning and gives orientation for building skills and capability for making healthy food choices.

The nutrition and agriculture integration approach in the NSMP connects the phases of food production and consumption through institutional purchases. This process also contains two transversal elements: territory and knowledge building, which use food and nutrition education as a strategy (Fig. 4). A food production model based on family farming and traditional cultivation practices tends to supply socio-biodiversity foods (regional foods) that are potentially organic and/or agroecological. These basic foodstuffs must be part of school meal menus that are planned according to nutritional needs, epidemiological profiles, seasonal principles, traditions, and food culture (Fig. 4).

4 Connections of FNS Policies and Sustainability in Brazil

The analyses presented above address the approaches for integrating nutrition and agriculture from the perspective of the diverse connections between the rural and the urban. This integration occurs because of and through eating practices. Besides

providing important access to the nutrients necessary for maintaining and promoting good nutrition and thus, human health, food has also the potential to connect different geographical locations and distinct cultures, as well to inspire ways to experience the world and to bring people together. Thus, integrating nutrition and agriculture include expressions of culture, economy, social struggle, and resistance (Friedmann 2005; Patel 2008). This is an important component of the complex relationships between urban and rural areas (Breilh 2010).

A common denominator among the dimensions of sustainability that are part of the discussion on food systems is the need to address the current healthy diet without compromising future needs (Monteiro et al. 2015; Summer 2017). The instruments for promoting healthy eating and nutrition that we analyzed allow us to establish other connections with sustainability that involve specific dimensions: holistic, social, environmental, social participation, and cultural.

The holistic dimension contains two concepts. One that reinforces the premise that current demands for food should not compromise the future needs, thus connecting different generations. The other addresses the connection between biological, social, cultural, economic, and environmental aspects found in the food and nutrition processes. The social dimension has aspects such as promoting equity and social justice, providing access to information and capacity building related to healthy eating and nutrition, providing all Brazilian citizens with regular and permanent access to food, and connecting consumers to local producers. The environmental dimension contains elements that address the impacts of food choices, the food production with less environmental impact (agroecological and organic), and the choice of non-genetically modified foods as well as the consumption of food according to biome. The social participation dimension contains elements such as advocacy for promoting healthy eating and nutrition, exchanging experiences and providing mutual support to overcome day-to-day nutrition problems, working at different levels of administration, and decision-making. Last, but equally important, is the cultural dimension that is associated to local food culture and related with the act of eating, which should stimulate pleasure, happiness, and a sense of belonging.

5 Concluding Remarks

In this chapter, we have sought to reflect about the integration of agriculture and nutrition in two Brazilian food and nutrition security policy instruments, as well as to address the linkages between promoting healthy eating, nutrition, and sustainability.

The strategies to integrate nutrition and agriculture as highlighted in the instruments analyzed add the perspective of sustainability to the promotion of healthy eating and nutrition through associating food production to family farming, valuing culture and local production, and arguing for less consumption of processed foods. This perspective results in desirable characteristics of food production such

as giving value to local production and stimulating the consumption of diversified and agroecological food produced by family farmers, indigenous groups, or traditional communities. Notwithstanding, further research is needed for going deeper in some of these elements, for instance, the meanings attributed to the term 'local', or the types of practices adopted by family farmers that could contribute to sustainable food production. The interactions between practices of cultivating food, ecosystems, culture, and consumers' behavior in different territories. And there is also a need to understand the connections between the intersectoral policies that aim to promote health eating and the food systems arrangements in the different government levels. On the other hand, it is also important to propose the integrated evaluation that account the health and nutrition outcomes, economic grow, more equitable development, and others.

Therefore, the chapter argues for integrating nutrition and agriculture in a systematic approach based on establishing direct relationship between food consumption and production. As for the association with sustainability, the above mentioned elements qualify the linkages relating diets for improved human health and nutrition with an agricultural sector that promotes food and ecological diversity under socially fair and environmentally sustainable patterns (Jones and Ejeta 2015; Horton et al 2016). This chapter showed that both the National School Meal Program and the Brazilian Food Guide are instruments that promote healthy eating and nutrition by developing intersectoral actions, which can also contribute to addressing other broader goals such better income for family farmers, reducing vulnerability, empowering women in the food production and consumption process, and others.

Furthermore, the lessons learned from these instruments can help create new ways to address other local, national, or international goals. This is the case of developing actions to meet the Sustainable Development Goals (SDGs) which is here taken as an external agenda that encompasses global challenges and also depict Brazil's long-standing social demands. For addressing the 17 SDGs and their 169 targets governments should foster social participation and dialogue with society and their demands, a path that Brazil has been following over the last two decades. The Brazilian experience also display how strategic is strengthen the existing intersectoral policies and programs to addressing the SDGs in an integrated manner.

A national plan to attain the SDGs should be the outcome of a policy making process gathering various government areas and different segments of civil society, including teaching and research institutions. Profiting from the country's own experience, the deliberations produced at the National Conferences in various policy sectors (health, education, food and nutrition security, environment, cities, rural development, etc.) can contribute to building an approach founded on Brazilian population's real needs and make addressing the SDGs possible.

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Health and Sustainability: Reinforcing Public and Private Engagement Through Tertiary Institutions

Artie W. Ng, Ben Y. F. Fong and Tiffany C. H. Leung

Abstract Increasing efforts are observed among the regulators to encourage corporate social responsibility (CSR) and sustainability reporting among the listed profit-making enterprises as a means of balancing act for the society. However, such enthusiasm has been linked largely for the interests of the financial stakeholders, namely the investors, stockholders and financiers in general for the relationship to corporate performance and risk management. From a social scientist's point of view, such a focus is considered rather myopic in light of the social and environmental implications. In particular, the ultimate concerns in association with human health have been largely ignored. Through literature review, a conceptual framework to link health and sustainability as accountable by both public and private sectors is proposed. Exploring the case of Hong Kong as an international city and financial centre, we argue that there could have been an even stronger dynamic process for promoting health and sustainability as currently practiced. We adopt a social scientist approach and argue that accountability, if serving the public interests, should be extended to the underlying social and health costs associated with environmental un-sustainability. Tertiary institutions, namely universities could take up a strategic, moderating role as an independent hub to integrate efforts of the government, the business sector and the communities at large to enable a dynamic process for health, sustainability and quality of life through recurring programmes of learning, teaching and research.

Keywords Sustainability · Sustainable development · Health · ESG reporting

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1 Background

In the twentieth century, there has been a substantial increase in world population and unprecedented economic growth. World population reached more than 7.35 billion people in 2015, whereas average life expectancy is 71.4 years in 2015 (The World Bank 2017). This progress poses a challenge on environmental sustainability and health issue.

The United Nations consulted 1360 international experts in environmental sustainability in 2005 (Hoffman and Bansal 2012). The Millennium Ecosystem Assessment (2005 p. 1) concluded that human beings have continuously changed the ecosystems in this century "more rapidly and extensively than in any comparable period of time in human history". This excessive human development caused a growing list of environmental crises and problems, such as toxic wastes, ozone depletion, and greenhouse gas emission (Hoffman and Bansal 2012). The public has witnessed global climate change, such as, the polar ice melting in Arctic region, the flooding in Southeast Asia, and severe droughts in Africa (Hoffman and Bansal 2012).

The United Nations Principles of Responsible Investment (UNPRI) (2010) found that the 3,000 global corporations produced US$ 2.15 trillion worth of environmental destruction and pollution in 2008. Arguably, the corporate sector has increasingly seen as the main contributor of the environmental degradation. The report contended that governments adopt "polluter pays" principles that corporations would have to pay compensation for the environmental damage they caused in the past (UNPRI 2010).

Multinational companies (MNCs) and their major suppliers are frequently facing an increasing number of ethical, social and environmental issues (Noronha et al. 2015). The factories of MNCs are often located in the developing countries, notably Mainland China. The major social and environmental incidents have been widely exposed to the international social media that have substantially affected the Chinese image and corporate reputation as one of the leading world factories (Noronha et al. 2015).

In particular, China has been experiencing substantial economic development and social transformation over the past few decades; however, this economic progress has caused undesirable negative externalities to the natural environment. Three main attributable deaths from ambient particulate matter (PM) 2.5 in China are industrial coal, traffic, and domestic biomass burning (The World Bank 2016). Research studies report similarly alarming results regarding toxic air in the country. As reported by Yan (2016), severe air pollution and smog could be a cause of shortened life expectancy in China ranging from 25 months to 65 months.[1] These studies revealed that over 30% of deaths in 2013 in the Beijing-Tianjin-Hebei, the

[1]These estimates are based on two studies completed by International Energy Agency as well as a group of researchers from the Massachusetts Institute of Technology in the US, Tsinghua University, Peking University in China, and Hebrew University of Jerusalem, respectively (Yan 2016).

Yangtze River Delta and the Pearl River Delta could be highly related to PM 2.5 pollution (Yan 2016). Hong Kong, located in the southeast coast of Mainland China, has also faced a deteriorating environment due toxic air from Mainland China. As Air Quality Health Index (AQHI) is often ranked 7th out of 11 tier in Hong Kong, local people are exposed to nearly 1500 h of air pollution that induced a number of high health risk in 2016 (Yan 2016).

In light of these undesirable negative externalities to the natural environment in China and Hong Kong, this book chapter aims to explore on how the concept of health and sustainability could be reinforced by public and private sectors through tertiary institutions. This chapter starts with providing some background information on sustainability and sustainable development as a global initiative and the post-2015 sustainable development. The next section presents a conceptual framework to show the linkage between health and sustainability, followed by public, private and community. Global movements in social and environment practices, the case of Hong Kong as an International City in Asia, as well as the important moderating role of tertiary institutions, are discussed. Concluding remarks are provided in the last section.

2 Global Sustainable Development

2.1 Sustainability and Sustainable Development as a Global Initiative

Sustainability or sustainable development has become a central theme in 1990s. According to *Our Common Future* published by World Commission on Environment and Development (WCED 1987, p. 43), sustainable development has been broadly defined as "*development that meets the needs of the present without compromising the ability of future generations to meet their own needs*". In other words, sustainable development tends to focus on how to manage human activities in order to meet physical and psychological needs without compromising economic, social, and environmental dimensions (Unerman et al. 2007).

In 1992, the United Nations organised a major international conference, which is called the United Nations Conference on Environment and Development (UNCED) at Rio de Janeiro to discuss climate change issues. This conference was an initial development for environmental policy and received 166 signatures from different countries (Blowfield and Murray 2014). Further, in the first opening paragraphs of *Agenda 21*, an enormous target list of world action was adopted at *the Earth Summit* in 1992. *Agenda 21* (UNCED 1992, p. 4) states,

> In order to meet the challenges of environment and development, States decide 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.

Both *the Earth Summit* and *Agenda 21* were an important step to establish environmental policies. In 1997, the United Nations National Framework Convention on Climate Change (UNFCCC) organised a summit in Kyoto to establish a legally binding protocol to enforce countries to reduce greenhouse gas emission (Blowfield and Murray 2014). The Kyoto Protocol was effective in 2005; however, some countries, notably the US, Australia, Japan, China and India refused to sign this protocol due to the potential threat of economic growth (Blowfield and Murray 2014). The Fifth Assessment Report (5AR) published by Intergovernmental Panel on Climate Change (IPCC) (2015) states that there was 95% probability that climate change was being largely caused by human activities.

However, the concepts of sustainability and sustainable development still remain highly contested and different individuals, organisations and governments understand these terms differently (Herremans et al. 2009). In particular, the role of organisations in sustainable development is significant in most developed countries (Unerman et al. 2007). Regarding sustainable development policies and practices, most organisations adopt the triple bottom-line framework suggested by Elkington (1997) that integrates economic, social and environmental responsibilities into their business agenda. However, most organisations tend not to take the Brundtland definition seriously and fail to incorporate into organisational logics (Herremans et al. 2009). Critical scholars argue that many businesses often adopt the concepts of sustainability and sustainable development as a part of corporate strategies, such as risk and cost reduction, reputation enhancement, and gaining competitive advantage (Kurucz et al. 2008). Other businesses merely adopt these concepts as a public relation tool to gain support and approval of a range of powerful stakeholder groups in the business environment (Unerman et al. 2007).

2.2 The Post-2015 Sustainable Development

The United Nations (2000) well established eight Millennium Development Goals to improve the living conditions of developing countries. The goals endeavour to eradicate extreme poverty and hunger, improve literacy rate, promote gender quality, reduce child morality, improve maternal health, combat HIV/AIDS, malaria and other major diseases, ensure environmental sustainability and develop a global partnership for development (The United Nations 2000). After 15 years, the United Nations unveiled the post-2015 sustainable development agenda to develop major indicators and targets emphasizing health as an outcome of policies to enhance sustainable development (Dora et al. 2015). Healthy places are resilient and environmentally sustainable as cities with clean air, energy-efficient infrastructure, and accessible green places could attract more investment, create more job opportunities (WHO 2016a). Arguably, health could be viewed as a prerequisite for sustainable development (Hancock 1999; Kickbusch 2010).

Healthy people are in a better position to work and contribute to the society. Sustainable development initiatives will benefit population health with

well-planned and prioritized community interventions (PAHO 2013). However, it is argued that health promotion strategies in practice are not well integrated with those for sustainable development; health and sustainability should be considered "mutually enabling and constraining" (Kjærgård et al. 2013, p. 6).

3 The Linkage Between Health and Sustainability—A Conceptual Framework

While Elkington (1997) has long advocated the adoption of the triple bottom-line framework to integrate economic, social and environmental responsibilities into business agendas, there are three main issues that are yet to be addressed in practice for sustainability in the society under such a framework. First, many business organisations are still taking sustainability reporting as a public relation tool rather than embedding it as part of their strategic plans (Unerman et al. 2007). Second, linkage between health and sustainability is largely ignored in the framework and the external social costs associated with environmental sustainability are unrecognized as well (Hancock 1999; Kickbusch 2010; WHO 2016a). Third, the role of the government has not been considered under the triple bottom-line framework.

Some operational frameworks that are sustainable, including industrial ecology, natural step, environmental management systems, environmental design, and green engineering have been developed in some prior studies (IOM 2013). The environment, both physical and socioeconomic as well as cultural, has direct impact on health. For example, where homes and roads are built may determine how far people walk or travel, how much air pollution is produced, and how much forests are removed, resulting in water pollution (IOM 2013). Health beliefs affect treatment seeking behavior, which is also determined by affordability and access of healthcare services.

To address these concerns, we propose a Framework for a Dynamic Cycle of Health and Sustainability (see Fig. 1). It demonstrates the linkages and the causal relationships among economic, environmental and social sustainability which in turn require reinforcements to ensure continuous, positive development for health and sustainability. The involvement of the key stakeholders from both public and private sectors is both inevitable and necessary for momentum and success.

4 Public, Private and Community

Promoting health and wellbeing, and disease prevention, by addressing the behavioural, societal and environmental risk factors, can reduce disease burden, thus cutting health care cost, and increasing productivity. These concerted efforts that embrace the significance of acceptance by the local societies will lead to sustainable

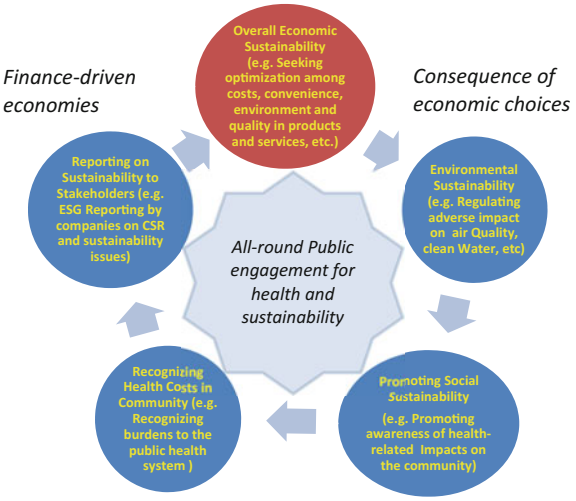

Fig. 1 Proposal framework for a dynamic cycle of health and sustainability

and favourable social and economic development, incorporated in the health in all policy for the long-term benefits of the public (PAHO 2013). A conference was staged by the World Health Organization (WHO) in 2017, following 10 years of practical application of Health in All Policies in the State of South Australia, to share the experiences at national and subnational levels, and to address some current wide-ranging and interconnected health and development challenges (WHO 2017).

The conference highlighted the crucial role of fostering meaningful participation and inclusive policy, with an emphasis that health is a political choice of the governments. Sustainable developments require joint action and policy coherence through the various levels of the government. At the same time, health literacy is critical to good governance, with equity impacts to the public. Thus, the Health in AII Policies approach is an integral part of good modern day governance, aiming at achieving the Sustainable Development Goals. This is a valuable investment and a tool in addressing health determinants and equity in the society through shared leadership in the government and the community. Ultimately co-benefits are ensured, based on sound evidence (WHO 2017).

Sustainable interventions, often through societal mechanisms, including legislation and taxes, can considerably improve the quality of life for communities, families, and children through programmes that address the complex social problems, like obesity, poverty, and crime in order to raise the visibility of positive outcomes (IOM 2013). In general, health should be considered as the outcome of any sustainability development initiatives and policies such as Health in AII Policies, for which the Health Impact Assessment (HIA) should be adopted. HIA examines the health impacts of policies, plans and projects in diverse economic

sectors using different types of research methods, such as quantitative, qualitative and participatory techniques. It also helps to set goals, defines indicators and monitor implementation of policies, thus allowing choices about alternatives and improvements to prevent disease and injury, and to promote health (PAHO 2013).

The governments and the public sector cannot act alone in achieving health and sustainability in the society. The private sector, including the health industry as the case in most developed countries, has a major role in the endeavors. Private enterprises and organisations are in strategic and economic positions to contribute to the health of the communities they serve and from whom they have derived economic gains. They are encouraged to subscribe to the philosophy of sustainable developments and observe the related policies and laws. By doing so, adverse effects, if any, from commercial and industrial activities would be reduced to the minimum, or at least controlled at the acceptable levels, while at the same time, potential benefits to the community can be attained by socially responsible private companies. In a collaborative partnership, the private health sector needs to become a leader where health issues are concerned, by proposing adaptation strategies to the government in order to strengthen health systems (IOM 2013).

In Victoria, Australia, a study conducted by Patrick et al. (2011) states that healthcare practitioners have included environmental concerns into their practice. The group has explored key barriers and facilitators to incorporating sustainability into community based healthcare practice (Patrick et al. 2011). Even though there are multiple barriers related to availability of funding and policy direction, the principles and practices of health promotion as an integral part of the healthcare system are seen to facilitate and enable action on sustainability (Patrick et al. 2011).

While it is recognised that the relationship and causality between health and development go both ways, development has resulted in massive economic growth and substantial health benefits for local community. However, the consequences of the environmental effects of development, such as climate change, urbanisation, and the disruption of essential ecosystem services, cannot be ignored. Hence, an understanding the potential negative health effects should be the core discussion of sustainable developments, particularly in consideration of social supports and public safety structures (IOM 2013).

Dr. Margaret Chan, Director General of the WHO, has commented that health is being compromised by the mounting forces arising from ageing population, unplanned urbanisation, and the globalised marketing of unhealthy products (WHO 2016b). Moreover, building fundamental capacities of nation for enhanced capacities in health is the best exit strategy for providing assistance to developing countries (WHO 2016b). According to the WHO, the 2030 Agenda for Sustainable Development seeks to shape a new world, and the factors that monitor the human condition, and the planet that sustains such human condition, are no longer so discrete (WHO 2016b).

5 Global Movement in Social and Environmental Reporting Practice

A spate of social and environmental disasters, such as Bhopal in 1984, Chernobyl in 1986, and Exxon Valdex in 1989, have played an important movement to change stakeholder expectation (Gray and Herremans 2012). These environmental disasters are regarded as negative externalities, which have never been included in financial statements. There are difficulties in quantifying and measuring these environmental externalities in financial terms. Nowadays, environmental-sensitive companies tend to include environmental cost management, which is the strategic management systems for identifying, monitoring and measuring the visible or hidden private environmental costs caused by business activities (Hilton and Platt 2015). The emergence of social and environmental reporting was stimulated by a various initiatives in early 1990s, including the European Union Eco-Management and Audit Scheme (ISO14000 Series), the United Nations Environment Programme (UNEP)/ Sustainability, and Public Environmental Reporting Initiative (PERI) Guideline (Blowfield and Murray 2014).

The development of social and environmental reports or even the stand-alone reports have gradually continued to gain attention. Klynveld Peat Marwick Goerdeler (KPMG), a worldwide accounting firm, has systematically accessed these voluntary reports since 1997 (Gray and Herremans 2012). According to KPMG (2015) international survey, over 90% in 2015 and over 75% of national 100 companies in both developed and developing countries report on the non-financial information, such as social and environmental information, in annual reports and standalone sustainability reports. The multinational companies tend to pay less attention to social stakeholders, such as local communities, or even the primary nonsocial stakeholders, namely natural environment, nonhuman generations and nonhuman species. Currently, the environmentally sensitive industries, such as mining, automotive, oil and gas, disclose more social and environmental information on their annual reports or standalone reports, with a global reporting rate more than 78% in 2015 (KPMG 2015). However, non-environmentally sensitive industries, such as healthcare, retail and leisure, still lag behind all other industries, with a global reporting rate below 65% in 2015 (KPMG 2015).

More pertinently, Global Reporting Initiative (GRI) Sustainability Reporting Guideline is a multi-stakeholder approach to develop a framework for economic, social and environmental reporting, which is largely similar to a common accounting standard, namely, Generally Accepted Accounting Principles (GAAP) for financial reports (Gray and Herremans 2012). The Global 250 companies adopt the most popular voluntary GRI guideline with three main disclosure categories, namely economic, environmental and social dimensions, while social dimensions are subdivided into four dimensions, including labour practices and decent work, human rights, society and product responsibility (Global Reporting Initiative 2015). The application rate of GRI among the multinational companies is above 72% in

2015 (Global Reporting Initiative 2015). The GRI G4 Guideline provides a set of principles and guidelines on how to disclose content, quality and reporting dimensions (Gray and Herremans 2012).

Apart from the international reporting practices, there are specific reporting obligations on non-financial information in the Western stock exchange markets, such as the London Stock Exchange (LSX), the Australian Securities Exchange (ASX) and the Securities Exchange Commission (SEC). Regarding Asian stock exchange market, the Shenzhen Stock Exchange (SSE) in 2006, the Shanghai Stock Exchange in 2008 (SZSE), and the Singapore Exchange (SGX) in 2011 established new guidelines for listed companies to disclose Environmental, Social and Governance (ESG) information in Hong Kong.

6 The Case of Hong Kong as an International City in Asia

6.1 Environmental, Social and Governance Practices in Hong Kong

As an international financial centre, Hong Kong has been proactive in adopting international standards and practices as a strategy to maintain its global relevance and competitiveness. Following the initiatives of its main rival in Singapore, the Hong Kong Exchanges and Clearing (HKEX) in 2011 released a consultation paper for the Environmental, Social and Governance Reporting Guide (the ESG Guide) and followed by consecutive years reviews and collected current any ESG reporting guidelines or frameworks, for example the Global Reporting Initiative (GRI), International Organization for Standardization (ISO) 26000 or Dow Jones Sustainability Indices (DJSI) (Hong Kong Exchanges and Clearing Limited 2015). Such regulatory measures from the international financial sector as s strategically advocated in Hong Kong would be complementary to the efforts made by its public and social policies for sustainability. However, a survey conducted by Bloomberg found that more than 50 per cent of sample 330 issuers in Hong Kong did not initially respond or report any ESG issues in 2014 (Hong Kong Exchanges and Clearing Limited 2015).

Nevertheless, after such initial thorough open consultation with the sector, it was determined that all Hong Kong listed companies are required to publish an ESG report annually. The purpose of this new guide is to improve environmental, social and governance (ESG) disclosure requirements and encourage issuers in HKEX to develop policies, improve risk management and report to investors and other stakeholders on non-financial information (Hong Kong Exchanges and Clearing Limited 2015). Table 1 highlights the environmental and social aspects in the new structure of the ESG Guide as proposed by HKEX in which Health and Safety has been identified as an area of performance. It focuses largely on two aspects of sustainability, namely environmental and social aspects of sustainability.

Table 1 New structure of the ESG guide in Hong Kong

Environmental aspects	***Social aspects***		
	Employment and labour practice	Operating practice	Community practice
Emission	Employment	Supply chain management	Community investments
Use of resources	Health and Safety	Product responsibility	
Environment and natural resources	Staff development and training	Anti-corruption	
	Labour standards		

Source Hong Kong Exchanges and Clearing Limited (2015)

The two main aspects are subdivided into four main areas: environment, employment and labour practice, operating practice and community practice. Each area has different aspects and issuers need to report "General Disclosures" and Key Performance Indicators (KPIs) (See Table 2) in order to show how issuers have performed on environmental and social impacts during the fiscal year (Hong Kong Exchanges and Clearing Limited 2015). These main aspects are often reported in quantitative terms, for example the amount of emissions of toxic gases or amount of hazardous and non-hazardous waste (in tonnes), the number of employee fatalities, the percentage of products returned by customers for health and safety reasons, and the amount of money and time given to community projects (e.g. community health) (Hong Kong Exchanges and Clearing Limited 2015).

In addition, there are four main ESG reporting principles: (i) materiality refers to ESG issues become increasingly important to investors and external stakeholders, (ii) quantitative approach indicates that Key Performance Indicators (KPIs) should be measurable and accompanied by a narrative, (iii) consistency states that companies should adopt consistent measures for ESG comparisons over time, and (iv) balance notes that ESG report should offer an objective viewpoint of an issuer's ESG performance (Hong Kong Exchanges and Clearing Limited 2015).

6.2 An International City for Health and Sustainability

As a community initiative, the "Healthy Cities" movement was steered by WHO in 1986 (Hancock and Duhl 1988, p. 24), with the vision of continually creating and improving physical and social environments while developing community resources to enable a community to mutually support its members in functioning their lives for maximum potentials.

In 1990s, it was a major global movement for the new public health, advocating "Local Problems, Local Solutions and Local Resources" (Department of Health 2007, p. 18). There are seven guiding principles for development of Healthy City

Table 2 General disclosure and key performance indicators of ESG new guide in Hong Kong

A. Environment	*General disclosure*
Aspect A1: Emissions	General disclosure information on: (a) the policies; and (b) compliance with relevant laws and regulations that have a significant impact on the issuer relating to air and greenhouse gas emissions, discharges into water and land, and generation of hazardous and non-hazardous waste
Aspect A2: Use of resources	General disclosure policies on the efficient use of resources, including energy, water and other raw materials. Note: Resources may be used in production, in storage, transportation, in buildings, electronic equipment, etc.
Aspect A3: The environment and natural resources	General disclosure: Policies on minimising the issuer's significant impact on the environment and natural resources
B. Social	*General disclosure*
Aspect B1: Employment	General disclosure Information on: (a) the policies; and (b) compliance with relevant laws and regulations that have a significant impact on the issuer relating to compensation and dismissal, recruitment and promotion, working hours, rest periods, equal opportunity, diversity, anti-discrimination, and other benefits and welfare
Aspect B2: Health and safety	General disclosure Information on: (a) the policies; and (b) compliance with relevant laws and regulations that have a significant impact on the issuer relating to providing a safe working environment and protecting employees from occupational hazards
Aspect B3: Development and training	General disclosure Policies on improving employees' knowledge and skills for discharging duties at work. Description of training activities. Note: Training refers to vocational training. It may include internal and external courses paid by the employer
Aspect B4: Labour standards	General disclosure Information on: (a) the policies; and (b) compliance with relevant laws and regulations that have a significant impact on the issuer relating to preventing child and forced labour
Operating practices	*General disclosure*
Aspect B5: Supply chain management	General disclosure Policies on managing environmental and social risks of the supply chain
Aspect B6: Product responsibility	General disclosure information on: (a) the policies; and (b) compliance with relevant laws and regulations that have a significant impact on the issuer relating to health and safety, advertising, labelling and privacy matters relating to products and services provided and methods of redress
Aspect B7: Anti-corruption	General disclosure information on: (a) the policies; and (b) compliance with relevant laws and regulations that have a significant impact on the issuer relating to bribery, extortion, fraud and money laundering

(continued)

Table 2 (continued)

Community	*General disclosure*
Aspect B8: community investment	General disclosure policies on community engagement to understand the needs of the communities where the issuer operates and to ensure its activities take into consideration the communities' interests

Source Hong Kong Exchanges and Clearing Limited (2015, Appendix II, p. 7−15)

Projects (HCP), namely inter-sectoral collaboration, community participation, and equity in health, health promotion, primary health care, evidence-based approach and international cooperation (AFHC 2014). The first Healthy City Project of Hong Kong was started in 1997 in the Sai Kung District. Tremendous efforts were made in engaging the community to promote health awareness, building a healthy community through collaborative efforts, and establishing a cohesive inter-sectoral partnership infrastructure conducive to sustainable development. The China Hong Kong Chapter of the Alliance for Health Cities (AFHC) was subsequently founded in 2007 and the associated "Healthy Cities" Forum was attended 500 local and overseas delegates. Two years later, all the eighteen administrative districts in Hong Kong had established their HCPs, with structures and mechanisms tailored to characteristics and needs of individual geographic communities (AFHC 2014).

On the other hand, the *Change for Health* website has been launched by the Department of Health with the objective to implement the strategy for non-communicable diseases (NCD) prevention and control successfully (Department of Health 2017b). The Department has also established the *HealthyHK* website, which is a Public Health Information System containing various health-related databases in Hong Kong for policy formulation, needs assessment and monitoring and evaluation of public health services, in the hope of assuring the sustainability of efforts at all points of health care (Department of Health 2017c).

In fact, people in Hong Kong enjoy the longest life expectancy and top standards of health because of improved social conditions, health education, and high quality and equitable healthcare services. As part of the sustainable development for the 21 century, public and personal hygiene issues, and health of the community are assured through the strengthening of public health programmes and community initiatives such as the Healthy Living Campaign, raising awareness of personal and, environmental hygiene and cleanliness (Planning Department 2017).

The Hong Kong Government established the Centre for Health Protection back in 2004 to develop the capacity of the local public health system to deal with various important public health challenges and to prevent communicable and non-communicable diseases with the 3 'P's commitment: *Protect the health of the community; Promote healthy living; and Partner with stakeholders*, in collaboration with local and international partners (Department of Health 2017a). The Centre focuses on the '3Rs'—real-time surveillance, rapid intervention and responsive risk communication, in fighting communicable diseases. For non-communicable

diseases (NCD), the emphasis is on promoting healthy living in the community via a comprehensive strategy (Department of Health 2017a). To address the common NCD and risk factors, the Government considers the responsibility of prevention and control should go beyond the health sector (Department of Health 2017a). All stakeholders have a role to play and work collaboratively. The Government also promulgates healthy policies and control health hazards. The community is made aware of health issues and risks with better understanding about their responsibility for their own health. The non-governmental organisations (NGOs) and community groups are capable of implementing health promotion programmes for particular health issues among targeted population subgroups, while health care providers can promote health education (Department of Health 2017a).

With respect to advocating sustainable development, the Hong Kong Government established the Council for Sustainable Development (CSD) in 2003 as a key initiative to promote sustainability in Hong Kong with a linkage to quality of life (Environment Bureau 2017). It has largely defined sustainable development for Hong Kong as the following idealism:

(i) seeking ways to improve prosperity and quality of life while minimising overall pollution and waste;
(ii) meeting one's needs and aspirations without doing harms to the prospects of future generations; and
(iii) reducing burdens to the environment while helping preserve common resources.

Gaining support from the Environment Bureau of the Government, CSD has a mandate to engage the public stakeholders and their communities as aiming to develop a sustainable development strategy for Hong Kong with economic, social and environmental perspectives. The stakeholders engaged by CSD include expertise in the environmental, social and business sectors, as well as senior government officials under a forum for soliciting views on key issues related to Hong Kong's long term sustainability.

6.3 Efforts to Promote Health and Sustainability

In a prior study, Lee (2016) considers that urbanisation can be beneficial for health, given a supportive political structure. Improved mortality and morbidity rates have been observed in highly urbanised countries, particularly those with social system based on democracy and strong equity policies, resulting in great social and health achievements. In the case of Hong Kong, Lee (2016, p. 2) has conducted the community diagnosis of over ten districts. The research team have identified some important key issues related to sustainable urban development and healthy governance as follows: "The residents were found to have sub-optimal level of physical activities and healthy eating, high prevalence of chronic illnesses, high level of

stress, low level of connectedness as reflected by neighbourhood and interpersonal relationship, concerns with availability and accessibility to facilities for social support and enhancement of healthy living" (Lee 2016, p. 2). Improving the environment for health as well as pro-active and coordinated urban planning are recommended interventions by the Knowledge Network on Urban Settings of the WHO (Lee 2016).

"Health for all" is built on the basis of participation by all. Participation is not confined to passively receiving service when needed, but also proactively in becoming aware of health and partners in the promotion of health in the community. Tertiary institutions for higher education, namely universities, have potentials to protect the health of staff and students, and to provide holistic health-conducive working, learning, and living settings with sustainability. Leading examples include Lancaster and Central Lancashire, two of the very first universities in Europe to establish health-promoting university projects in 1990s (Tsouros et al. 1998). Students are equally vulnerable as staff to physical and psychological illnesses such as stress. Many of these health problems may be prevented or managed if identified early.

6.4 Universities as the Hub for Health and Sustainability

As a major tertiary institution based in Hong Kong, the Chinese University of Hong Kong began an innovative annual event in 2003. The Campus Health Ambassadors (CHA) programme, in conjunction with the University Health Service, aims to motivate and train a group of students who are enthusiastically committed to becoming the key advocates in promoting physical and psychological health issues within the university community. The programme fosters a culture of health awareness and practice among student groups. As these young people are innovative and energetic, they understand well the health concerns and needs of their peers. They are persuasive in passing health messages and participating in health projects. Eventually the CHAs are motivated with development of a positive attitude in health while establishing a leadership role in the campus and then in the community.

Universities should be considered as a resource hub as well as a partner among local, national and global communities. Representatives of the Health Ambassadors were introduced as they attended international conferences in Macau and Malaysia in 2004 and 2005 respectively. In collaboration with Shantou University in Chinese Mainland, the First Asia-Pacific Conference on Healthy Universities was conducted at the Chinese University of Hong Kong in 2007 (Fong 2007).

Universities can also provide a setting for students to develop independence and to learn life skills, through living or spending time away from home and frequently through experimenting and exploring (See Ng et al. 2017). For instance, at The Hong Kong Polytechnic University (PolyU), students are invited to take the Healthy Lifestyle Programme, covering different dimensions of health that aims to build up a healthy lifestyle in the university. Students are expected to acquire,

synthesize, and evaluate knowledge on healthy living, to differentiate between useful health facts and myths about health, to identify components of healthy living that contribute in one's well-being, and to make responsible health decisions for self (PolyU 2017). PolyU has also organised health and sustainability-related conferences in collaboration with business and non-profit organisations to explore contemporary issues (CPCE Health Conference 2017). Students participate in these conferences to learn about these real-life issues and views of the stakeholders and potential employers.

The discipline of public health in Hong Kong has advanced to make use of big data and analytical methods to study the effect of how people live, work and interact with the physical and social environments. In particular, the Chinese University of Hong Kong, in conjunction with the Utrecht University and the University of Toronto, have commenced a research project to collect and analyze data on the impact of the living environment and 24-hour economy on human health with a combination of sensors, physical and statistical models (Utrecht University 2017).

7 Concluding Remarks

In this chapter, we propose a conceptual framework to point out the importance of a dynamic and continuous process for health and sustainability for the society. It is necessary for a government to strengthen the concerted efforts between the public and private sectors while recognizing the external costs associated with health due to issues with environmental sustainability. In the case of Hong Kong—the global financial centre of China, there are encouraging initiatives from the financial regulator, the environment bureau and the health department in their individual efforts for health and sustainability developments.

To reinforce such individual efforts, we highlight the critical role of the universities in the engagement with both local and international communities as well as the business sector to promote a dynamic and continuous process for health and sustainability. Tertiary institutions could mitigate the missing links or silos among the government departments and business sectors which have developed their particular policy and strategic agendas without much integrated efforts. Through lifelong education for the next generation and the public at large on the linkage between health and sustainability, universities can act as an independent platform and a resource hub to formulate and implement recurring teaching, learning and research programmes on interdisciplinary matters related to health and sustainability as well as quality of life ultimately. Through universities, we can also engage with the new generation early as they would face the adverse impacts of climate change and environmental un-sustainability which could deteriorate further in the coming decades. Such an effort needs to recur and be reinforced over the years to come.

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Part III
Governance for Sustainable Development

Using the IPBES Conceptual Framework to Study Governance, Institutional Arrangements and Drivers of Biodiversity Loss in Two Indian Cities

Sandhya Chandrasekharan

Abstract This article draws on a study that used the Conceptual Framework (CF) offered by the Intergovernmental Platform on Biodiversity and Ecosystem Services (IPBES) to examine the Convention for Biological Diversity (CBD) theme of Cities and Biodiversity in the Indian metropolitan cities of Chennai and Bengaluru. The focus is one element of the IPBES_CF in particular, 'Institutions and governance and other indirect drivers'. These cities, with populations already comparable to those of the largest urban agglomerations globally, are poised for exponential growth. The biodiversity and ecosystem-services related governance challenges that they face in this regard, are substantial. As governance itself is all-encompassing, the primary research in this study was delimited to exploring two key things. The first is the institutional architecture related to, and levels of awareness on biodiversity and ecosystem services, as well as the synergy or lack thereof, within the local administration of these cities. The second is on the real estate housing sector as an emerging game-changer in the evolving scenario. Governance of this largely private industry is being attempted through voluntary certification and other soft policy approaches. Examples of good practices by a few builders/companies do exist. However, the scale and pace at which transformative change needs to be facilitated, and the ways and means by which this message can be effectively leveraged, remains a concern.

Keywords Cities · Governance · Biodiversity and Ecosystem-services Awareness levels · Green infrastructure

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1 Introduction: Background and Rationale for This Study

The conventional focus on biodiversity in India has been in biodiversity-rich areas —protected areas, forests and such, and not cities. The green and blue spaces in the urban areas have traditionally been part of the mandate of local and federal government administrative structures, mainly embedded with discourses on public health, sanitation, and urban planning in more generic ways. That the biodiversity and ecosystem service-values in particular, of green and blue spaces in cities needs more conscious engagement, from within governance structures, faces multiple challenges. As McPhearson et al. (2014) emphasises, ecosystem services critical to human and ecological health and well-being cannot all be sourced, like piped water, from elsewhere, and instead need to be supplied locally even within urban ecosystems. For instance, wetlands provide resilience in the event of floods. Urban green cover counters the effect of the urban heat island effect of built-up areas (ibid). But this is neither a widespread or commonly held understanding among powerful drivers of change, nor its stewards, in rapidly urbanising India. And this is perhaps typical of all developing and emerging economies.

The 'knock-on effects' (Puppim et al. 2011; p. 1303) on biodiversity more broadly, that consumption demands for water and other bioresources, land use transformation, and solid waste that Indian cities generate lead to, and how these are being managed (or not), is the key focus here. The oft quoted statistic, that more than half of humanity already lives in cities, which occupy only 2% of the world's land surface, yet are responsible for 75% of the world's natural resources consumed, and waste produced (Klein Goldewijk and Van Drecht 2006 cited in TEEB 2010) is still not a strong-enough, or obvious-enough linking-pin between 'biodiversity' and 'city governance' in tangible ways. By various estimates, the trend in urbanization will continue unabated and by 2050, 60–70% of the world's population will reside in urban areas (UN-Habitat 2016; UNDESA 2008). Over 90% of the urbanization is expected to occur in developing countries (UNFPA 2007), and the trend of the last century in India, only corroborates this view. India's urban population has roughly doubled every 50 years since 1901, as the Fig. 1 below captures.

1.1 Conceptual Framework Offered by the Inter-governmental Platform of Biodiversity and Ecosystem Services (IPBES)

The conceptual framework for biodiversity and ecosystems services (Fig. 2), developed mainly to support the analytical work of the IPBES, as part of its mandate to strengthen the science-policy interface, at various levels of governance, is deployed here as a generic framework and tool (Diaz et al. 2015; Decision IPBES 2/4). It is adaptable to various scales, and the focus here in on the national and local.

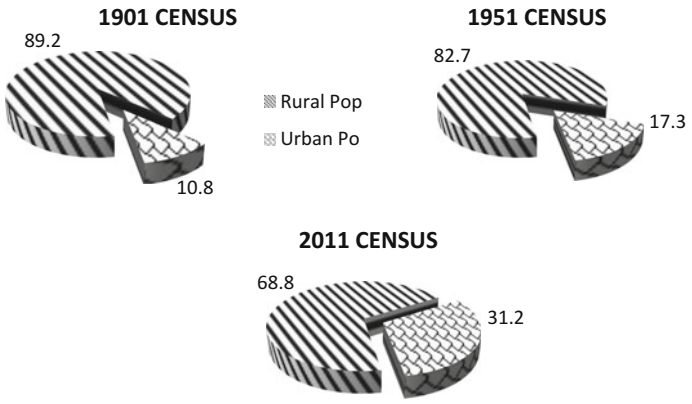

Fig. 1 Trends in urban-rural population in India. *Source* Adapted from Census of India, 1901, 1951 and 2011

It is being borrowed and used to help superimpose key, and useful concepts on the theme of Cities and Biodiversity more broadly, as emanating from the work of CBD, ICLEI, Stockholm Resilience Centre's Cities Biodiversity Outlook (CBO) and others.

2 Nature and Nature's Benefits to People in Indian Cities

That cities can and do sustain considerable biodiversity and extensive green areas, as highlighted by the CBO and others, is true for mega Indian urban centres as well. There are 10 urban centres with populations greater than 3 million, and they lead the over 40 cities in the country with a population exceeding 1 million and growing (2011 census). Together with the four old metropolitan centres of Mumbai, Delhi, Kolkatta, and Chennai; Bengaluru together with Hyderabad, Ahmedabad, Surat, Pune and Jaipur together represent the 10 biggest urban centres.

Some of these major Indian cities harbour a very high degree of biodiversity, comparable to those with the highest in the world. Various researchers and institutions have documented that:

- Urban forests account for 12.73% of the geographical area of Delhi, affording every inhabitant 10.5 m^2 (Forest Survey of India (2015), using population data of 2011). (Sethi 2015)
- Delhi and its surrounds—the National Capital Region (NCR)—has over 400 bird species, the second highest for any city after Nairobi (ibid)
- Bengaluru city has many urban parks where exotic species account for 77% of the trees. (ibid., Sudhira and Nagendra 2013)

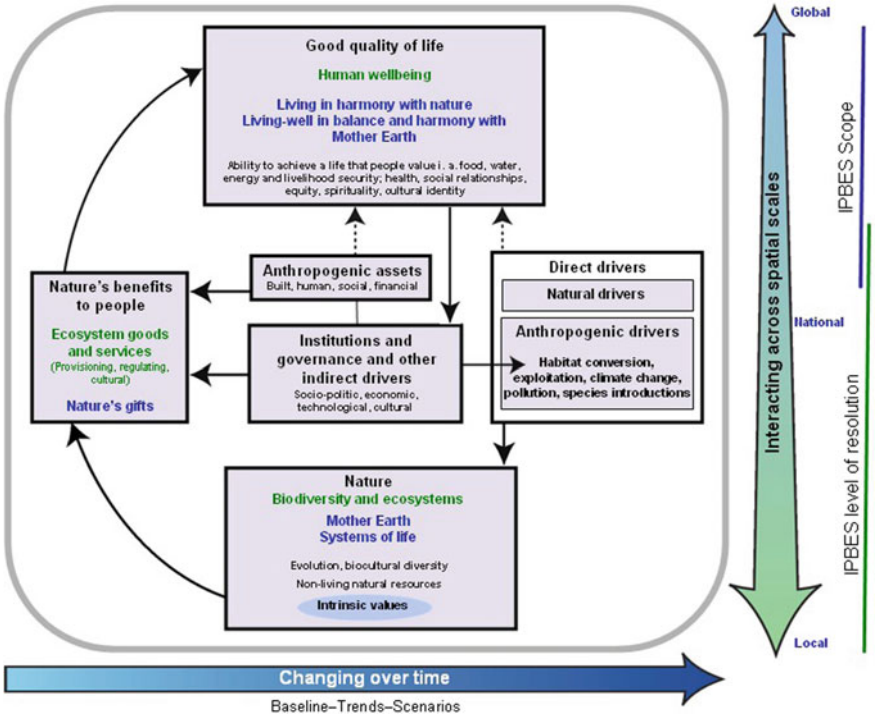

Fig. 2 The IPBES conceptual framework. *Source* Reproduced from http://www.ipbes.net/conceptual-framework

- Cities harbour the key biodiversity of their biogeographic zone. Pune in the Western Ghats has several species of amphibians (Sethi 2015). Chennai as a coastal city has mangrove ecosystems and much marine life; such as by being a nesting site for the Olive Ridley turtle.
- The existence of sanctuaries and national parks within or bordering cities is common. Eg. Mumbai has the Sanjay Gandhi National Park, Chennai Guindy National Park and Bengaluru the Bannarghatta Bioreserve (ibid).
- Natural or man-made wetlands and rivers criss-cross the urban Indian mosaic and attract thousands of migratory waterfowl every year (ibid., Chaudhry et al. 2011).
- Examples of urban managed wetlands also exist. The East Kolkata wetlands, for example, provide food and livelihood security to 0.2 million of the poorest peri-urban populations and provide up to 80% of the fish and 60% of the agriculture to the city of Kolkata (Sethi 2015).

Outside of charismatic biodiversity, and the aesthetic and recreational value of the green spaces where they exist, and the psychologically beneficial functions rendered by nature in the city; the important ecosystem services like clean air or

fresh water that substantially contribute to the quality of city life, are often not a primary focus for lay citizens and governance institutions alike unless they are threatened in some way. More pertinently, audits of the carrying capacity of administrative regions, owing to long-established and continually created and normalised centre-periphery relationships between cities and the rural hinterland—like say piped water from sources often not within their geographical precincts—adds to the complexity of why governance is not engaged with these questions.

2.1 Ecosystem Transformation in Bengaluru and Chennai

Bengaluru and Chennai are two-major cities in the southern part of India which have population sizes of a few million people. While geographically, both are in the south and less than 500 km apart, they are part of two distinct bio-geographic zones. India has 10 distinct bio-geographic zones (Rodgers and Panwar 1988) and while Bengaluru is in the Deccan Peninsula, Chennai is predominantly Coastal (Fig. 3).

Chennai, the capital city of the federal state of Tamilnadu is one of the oldest and the fourth largest city in the country. Population projections extrapolating from the 2011 census, estimate the population of the urban agglomeration to have crossed 10 mn in 2017 (http://worldpopulationreview.com/world-cities/chennai-population/, accessed March 2017). Bengaluru the capital of the state of Karnataka, and world-renowned as India's IT capital, its transformation from a pleasant cantonment town to the fifth largest city through expansion, migration and population growth (8.4 million in 2011), has been phenomenally rapid, and achieved in over just two decades (Sudhira and Nagendra 2013). The erstwhile town has been a long standing beneficiary of tanks and reservoirs that characterise the Deccan peninsula, the greater number of these artificially constructed (Faizi 2017).

The key ecosystem service that has been the topic of considerable discussion in recent times in both cities pertains to the quality and quantity of fresh water. The Chennai Metropolitan Area is reported to have had 650 waterbodies till a few decades ago, since reduced to only 30 (Janakarajan cited in Laksmi 2017). It also has two rivers—the Cooum and Adyar, and the artificially constructed Buckingham Canal. The city gets an average rainfall of 140 cm every year, with recorded rainfall of less than 100 cm (the anticipated ideal) having occurred only 5–6 times in the last few decades (Laksmi 2017). As a city on the high-energy coast of the Bay of Bengal, it is also no stranger to extreme climatic events (Jayaraman 2015). From the Indian ocean tsunami in December 2004 to depression-induced heavy rains that caused flooding in the city in December 2015 and a super cyclone in December 2016, the city has seen it all. Delving into the management of its ample waterbodies and the denuded resilience that would otherwise be offered by its original ecosystems presents an interesting case of the story behind a city that is prone to both water stress and urban floods. The combined capacity of the tanks and reservoirs is estimated to be 80 thousand million cubic feet of water (80 tmcft), but their current capacity, owing to poor maintenance and lack of periodic desilting is

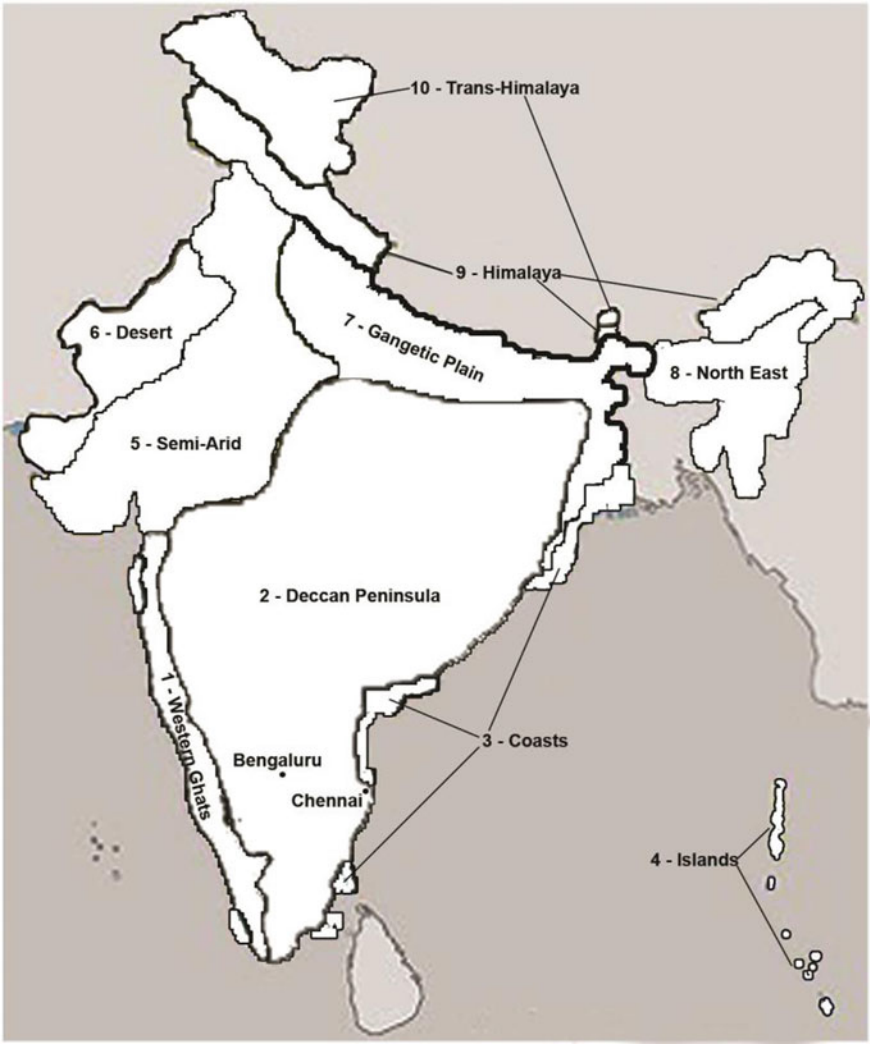

Fig. 3 India's biogeographic zones. *Source* Adapted and reproduced from Rodgers and Panwar (1988)

only 11 tmcft (Janakarajan cited in Laksmi 2017). Nearly 300 tmcft of rainwater drained into the sea in the 2015 floods as a result (ibid), leaving in its wake the world's 8th most expensive natural disaster for the year, estimated to have cost a USD 3 billion loss to the economy (Narasimhan 2015). New and post facto regularised urban infrastructure came sharply under the scanner from sections of academia, media and civil society—a new airport terminal on the floodplains of the River Adyar, a Mass Rapid Transit System constructed almost wholly over the Buckingham Canal and the erstwhile 50 square kilometre Pallikaranai marshlands,

an Information Technology (IT) corridor and engineering colleges constructed on waterbodies (Jayaraman 2015).

In Bengaluru, the story is not very different. A report by the Indian Institute of Science (IISc) shows that between 1973 and 2013 there has been an estimated 79% decrease in the total area of its many lakes and waterbodies, with over 50% of the area of lakes being built-up in violation of existing laws, and local government agencies being implicated in the same (Sengupta 2015). The matter was discussed in the state legislature as well (ibid). The city too has witnessed a spate of water-logging events after regular rainfall, and water shortages and dependence, as in Chennai, on the growing phenomena of private water markets, where private operators truck in water in tankers from peri-urban areas (Nelliyat 2016).

2.2 *Anthropogenic Assets and the Good Quality of Life in Cities*

The challenge of India's urban growth story today can be understood in the light of the rural-urban dichotomy in terms of conventional development indicators that was revealed in the decades preceding the 21st century. India's National Human Development report of 2001, shared the graphic reproduced below (Fig. 4), that captures, at a glance, what it meant to be an urban dweller in India, as against a person living in the rural areas, in those times. Comparing data across the 1980s and 1990s, while rural and urban income poverty was at comparable levels in both

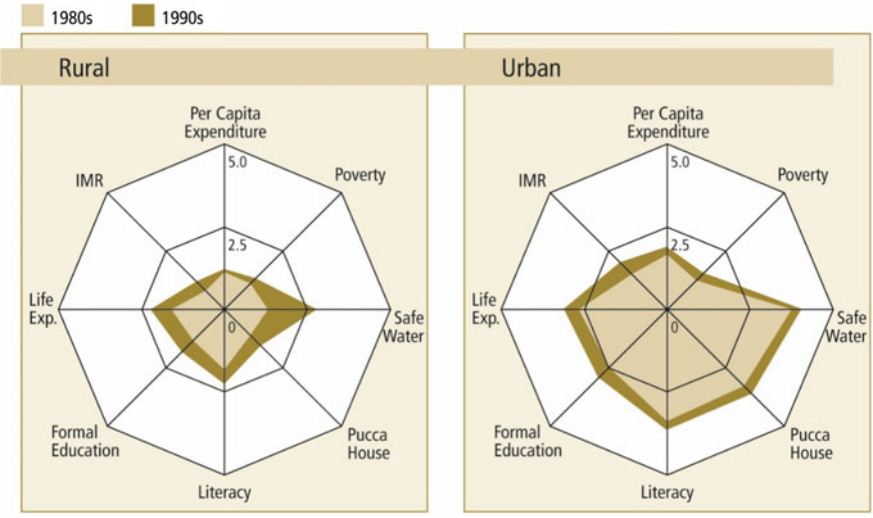

Fig. 4 Quality of life indicators for urban and rural India. *Source* Reproduced from the National Human Development Report 2001 of the Planning Commission, Government of India

decades, access to safe water and health indicators like infant mortality rates, and life expectancy, were much better in urban areas. Access to built-infrastructure resources like resilient housing and formal education were better by double or more than that of a rural counterpart for an urban-dweller. Access to safe water and nutrition requirements hinge on the biodiversity and ecosystem services, that even if not restricted in origin to the geographical precincts of cities, are more readily and reliably available to people there. The need to account for and address in all manner possible, the ecological costs at which such the better quality of life in urban areas is/was attained, systematically monitor and balance-out the trade-offs and effectively manage the negative impacts poses a huge challenge. This is what needs to be understood and informing the work of governance actors in more meaningful ways, in the present.

2.3 Institutions and Governance

Governance has been accorded a central place in the IPBES_CF schema, and referred to in various ways in key decision documents, especially Decision IPBES-2/4. However, it has not been defined anywhere in this document, which itself is noteworthy in social and political contexts where governance is simply understood as 'what government does' in the public administration sense of the term, as against something closely aligned to that, yet different. And that is governance as the nature and quality of government's interactions with key stakeholders, including citizens and the private sector, an idea that is central to literature on good governance (UNDESA 2006). Notably, what Decision IPBES-2/4 says is that:

1. "Governance systems" are one of the "drivers of change", or an external factor that affects nature and nature's benefits to people, as well as anthropogenic assets and quality of life.
2. "Institutions and governance systems and other indirect drivers" are the ways in which societies organize themselves, and the resulting influences on other components." They are further described as "key levers for decision making".
3. Governance is specifically highlighted in having a key role in relation to anthropogenic drivers of change.
4. At the national and subnational levels, governance is taken to mean "arrangements in ministries or laws that have *effectively contributed to* (emphasis added) to the protection, restoration and sustainable management of biodiversity".

In relation to the scope and focus of the present paper, the institutional architecture and levels of awareness on biodiversity and ecosystem service accounting, as well as the synergy or lack thereof, within the local administration of these cities will be examined to throw light on this one important facet of government as well as governance. Data was collected through a questionnaire with 20 questions and a semi-structured interview with the participating 27 officials. As the state capitals of

their respective states in India's federal structure, relevant state government departments that have a presence in the cities, were also covered. The Private Sector in relation to governance was studied in the context of the real estate sector for residential buildings. Governance of this largely private industry is being attempted through voluntary certification and other soft policy approaches. As habitat conversion and land-use conversion through 'sealing' into built-up areas are globally recognised drivers of biodiversity loss, the real-estate sector was chosen as a focus area. While housing real estate is only one part of the larger built infrastructure that is sealing land in Indian cities, it is expected to account for 60% of the new building development by 2050 (personal communication from a participant builder A). While a purposive sample of five builders each who advertised sustainability or green buildings on their websites, were chosen for each of the two cities, only one builder from either city actually consented and cooperated to permit on-site visits and discussions with the researcher, on the topic.

2.3.1 Awareness and Engagement with Biodiversity and Ecosystem Services (BES), as Well as the Synergy or Lack Thereof, Within the Local Administration

There are a several agencies and departments that can be designated 'government' ones, with a mandate to cover the biodiversity-related and biodiversity-impacting, as well as ecosystem services related functions of cities (Sudheera and Nagendra 2013). However, in keeping with their roles and functions dating back several decades, and pre-dating the environmental movement per se, their vision and mission, and day-to-day functioning, is more informed by public health and sanitation, and public administration-informed obligations more generically, than any ecologically or sustainability-science informed considerations or sensibilities. Irrespective of what their mandate stems from, the secondary data available indicates the following with regards to cities being able (or otherwise) to fulfil these functions:

1. Indian cities, on an average, generate only 37% of the funds that Urban Local Bodies (ULBs) spend, indicating a heavy dependence on State governments (ASICS 2016, p. 7)
2. Household coverage of Solid Waste Management (SWM) is only 35% in Indian cities in general, the waste collection efficiency in 70–90% in the larger cities (including Bengaluru and Chennai) and the extent of waste segregation is less than 50% (ibid., p. 10)
3. Using volunteers in governance was found in only 10 of the 21 cities surveyed by one NGO (ibid)

The key urban local body (ULB) and federal government agencies with a local presence covered in the course of this research are as indicated in Table 1.

Table 1 Local government institutions that were part of this study

Bengaluru	Chennai
Bruhat Bengaluru Mahanagara Palika (BBMP)	Greater Chennai Municipal Corporation—Department of Parks, Town Planning, Solid Waste Management
Bengaluru Development Authority (BDA)	Chennai Metropolitan Development Authority (CMDA)
Bengaluru Water Supply and Sewerage Board (BWSSB)	Chennai Metro Water
Lake Development Authority (LDA)	Department of forests
Department of Forests, Ecology and Environment	
State Biodiversity Board	

Officials were interviewed as well as requested to provide information to a standardised questionnaire to gauge their awareness and engagement with biodiversity and ecosystem services in the city.

In general, while the Department of Forests and the Department of Parks were concerned with protecting the green spaces and tree cover in the precincts of the city, the departments that were concerned with ecosystem services/addressing negative impacts on these and biodiversity were those governing SWM and those relating to water supply/sewerage and lake development. While the former have a purview of 'urban biodiversity' and are informed in their work by fairly clear mandates and legal and institutional structures that have a commitment to natural resource stewardship on the whole, the latter were less likely to connect their mandates to healthy ecosystems and the intrinsic value of these, but rather to routine administrative requirements. Water supply and sewerage as well as lake development, were considered technicist and mainly engineering-related matters, where the focus, to take the instance of lake development, was on the walk-way around the lake, the bund, and blocking (if possible) sewerage pipes being directed to the lakes. The biodiversity of lakes (whether in terms of fauna or fish or waterbirds) was not being monitored, and it was not in the mandate of these departments to do so either.

None of the officials had heard of the City Biodiversity Index (CBI). As showcased at the 11th CBD_COP hosted by India, the city of Hyderabad was supposed to have used it successfully in 2010. This raises questions on the degree to which experience and learning is shared within government, and the existence of avenues and requisite support for the same. While the Ministry of Urban Development (MoUD) has empanelled an NGO as a capacity building partner across all its urban missions; urban biodiversity and ecosystem service audits do not as yet feature as an element of the skill-building dimension in these (personal communication with the NGO representative). This makes the case for improved knowledge–sharing across government and better inter-ministerial collaboration where possible.

The majority of the respondents in Bengaluru (82%) were over 51 years old, while in Chennai 60% were aged 41–50, and the rest were over 51. There was a clear male majority (all except one respondent in Bengaluru, and likewise in Chennai). Slightly less than 50%, but the largest sub group of the respondents in Bengaluru, indicated that they had been in their current role for less than 2 years. Only 23.5% had been in their roles for over 10 years. In Chennai, in contrast, 50% (also the largest sub group) had been in their role for over 10 years. The strongest identity for most respondents (65% in Bengaluru and 60% in Chennai) was 'Government Employee', followed by choosing to describe (concurrently) their work as Environment Officers/Engineers/Scientists/Managers. The biggest sub-group in Bengaluru were those with a university degree, followed by those with a masters or Ph.D. In Chennai, the biggest subgroup had a masters degree.

When asked to identify which ecosystems were present in their city, most respondent from both cities, interestingly, were most likely to opt for that ecosystem that incidentally were also most recently in the news on account of either adverse impacts to these, or a disaster. Slightly over 70% of the respondents in Bengaluru opted for 'wetlands', and 100% of those in Chennai for 'sea'. The second most frequently indicated response was 'forests' (47%) in Bengaluru and 'wetlands' (40%) in Chennai. However, it is also revealing that the majority of their peers did not indicate awareness of these second-most commonly chosen ecosystems being part of their cities. Among the human constructed ecosystems that respondents identified as present in their cities, urban parks and botanical gardens were predictably the most commonly chosen responses in Bengaluru (88 and 76%). In Chennai it was urban parks followed by water channels (70 and 60%).

On how important they considered the major threats to biodiversity (in the context of urban areas), climate change, pollution and water scarcity were equally rated as the most serious issues by the majority (70.5%) in Bengaluru, followed by species loss, habitat loss, habitat fragmentation and invasive/exotic species. The respondents in Chennai unanimously indicated that pollution was what they felt was the biggest threat, followed by climate change (90%). Habitat fragmentation was what respondents tended to underestimate as a threat. To the question "According to you, are the biodiversity and ecosystem services, within the city, a key part of your work?" only 35% of the respondents in Bengaluru and 40% of those in Chennai, said "Yes, they form a core part", and here the bias of the response being collected face-to-face (though with the assurance that it would be collated and reported anonymously) was also a threat to the reliability of the answers. A similar percentage of respondents also stated "Somewhat yes—but I deal with only one aspect—water, or plants or land etc". The latter, while at one level is perhaps a more honest response, could also be interpreted to indicate that 'ecosystem thinking' is not pervasive within the formal institutional governance of cities. The respondents included those in charge of development of parks and playgrounds, solid waste management, storm water drainage, management of lakes and waterbodies, planting of trees/management of tree cover, land use zoning, planning and regulation; drinking water pumping and distribution, sewerage collection and waste water treatment.

In both cities, scientific management of solid waste through segregation at source was not something that the local governments were doing anything proactively about. The Solid Waste Management Rules (2016) were cited as the reason by one official for the same, on the grounds that the act puts the onus on the 'generator of the waste' (i.e: households) to separate it out into various streams, and awareness had not been created for the same. When asked why his/her office could not create the awareness, the answer was predictably lack of funds. While lack of funding may be a genuine issue, the power vested in the office and the scope to network or otherwise partner agencies that could support such efforts seems way beyond the modus operandi of these officials, indicating the flip-side of pervasive Public Administration thinking, that can easily cloak lack of responsiveness and inaction in 'waiting for procedure to take due course'. The lack of any initiative on their part, or a sense of their agency and doer-ship, and the absence of their being held accountable for this, was also revealing. Where laws exist, delays, apathy and the price of inaction being only social and environmental externalities, undermine the worth of existing legal frameworks for environment-related policy.

The Annual Survey of India's City Systems (ASICS) 2016, which examines city systems on the basis of several parameters including 'Urban capacities and resources' and 'Transparency, accountability and participation', reveals that Indian cities have a long road to travel in relation to internationally achieved standards on these. The survey, conducted by a Bengaluru-based NGO, argues on the basis of findings, that Indian cities need to strengthen their city systems including quality of laws, policies and institutions to improve service delivery. While voluntary sector catalysts have made a dent in improved water management through rainwater harvesting in Chennai, and encouraged better segregation of waste at source in Bengaluru, long term institutionalised and sustained change depends on revitalised administration. When parts of the challenge of controlling knock-on effects are sought to be addressed through command-instruments like legislation and schemes, there is a big gap in the implementation and translation of the intended change into tangible results on the ground. A legitimate starting point to address this problem is to ask whether the structural conditions are right for 'walking the talk' to happen. It is rather problematic that of the combined expenditure of union, state, and local governments; that of the last tier, closest to the people and with the bulk of service delivery functions, accounts for less than 6.5% (Mohapatra 2012). The case of SWM in cities where the best-case scenario is only 50% collection of segregated waste, and worst case is poor collection altogether (ASICS 2016), needs to be examined against facts like these.

2.3.2 Governance of the Indirect Driver (of Biodiversity Loss) of Housing Real Estate in Bengaluru and Chennai

The growth of the real estate-housing sector is a concomitant to the growth of the economy and demand for urban and semi-urban accommodations, as well as an investment and wealth-creation strategy given the strong cultural conditioning

towards home (and increasingly for the elite, dual and multiple home) ownership. Both Bengaluru and Chennai figure in the list of 'most favoured property destinations', with Bengaluru in the lead (www.ibef.org). Most housing in the projects of organised private developers is priced beyond the reach of the urban poor (Harish 2016). The Ministry of Housing and Urban Poverty Alleviation (MoHUPA), defines 'affordable housing' as 5 times the annual income of a household, and by that criteria, many people in India cannot afford home ownership in cities, though government is attempting to address this issue through directives to the private builders. Concomitantly, the market for rental housing is very high, and especially so in the urbanised areas of the southern states (ibid). In this scenario, the manner in which the real estate-housing sector's impacts as a driver of biodiversity loss and ecosystem services are being governed and managed, become pertinent to examine.

Governance of the sector is by and large voluntary and guided by certification and standards such as the Confederation of Indian Industry's (CII)—India Green Business Council (IGBC) and The Energy and Resources Institute's (TERI) Green Rating for Integrated Habitat Assessment (GRIHA). On the field, the nature and size of actors in the sector is widely varied, and reliable region/area/city-wise data on the sector on the whole in relation to sustainability-supporting characteristics is not available. Building this data base in itself would be an important first step in better governance. That said, it is an important area to examine private sector involvement in governance related to conservation and sustainable use of resources. To capture the diversity in the sector itself, this study examined a fairly small and niche developer in Bengaluru (Developer A) and a more established market leader in Chennai (Developer B).

Developer A's stated objective is to build homes have these elements in common across all segments of housing infrastructure (economy (INR. 1.5–1.7 mn), middle and high-end (INR. 20 mn))—being unplugged from city civic infrastructure for water and waste, have no borewells (which in India leads to unregulated ground-water extraction), zero import of water by tankers, zero waste export, and depend only 25–30% on the external energy grid by the regular builder's standard. Critical of inefficiency/wastage is seeking centralised solutions, he is in favour of more decentralised ones. One project site of high-end segments homes this builder generates 2300 units of the 6000 used, from solar panels. Builder A reposes great faith in a measure like directives to the town planning department, that for instance, all pumps must have BEE (Bureau of Energy Efficiency) rating, which he feels, much like the 20 micron plastic packet (allowed for retail outlets), is something that can be enforced by law. However, he is also aware of the slow responsiveness to appropriate change that such 'standards' can have, and the rigidity these introduce. BEE standard for instance, is less than 8 litre per min flow of water from a tap. The 5.5 l/min exists in the market, but there is no incentive/accountability in the system to encourage its use. Builder A maintains that legislation *can work* at both the supply and demand sides (industry and consumer).

Builder A shared that that the residential-building industry uses the services of 180 different vendors. The problem of poor education of architects and there being

no regulation on the 'approach' (a builder chose to, or failed to adapt) is where he located the problem. Consumer demand, and what is aesthetically or faddishly in vogue, without so much of a consideration for its ecological implications is what he felt, informed the work of architects and designers. Offering an example, the copper used in a conventional building in India, can be reduced by as much as 60% he said.

The interaction with Builder A explored how were they engaging with the 180 vendors, to get 'different'/ecologically sensitive products, how did they know what to ask for/what level of efficiency was possible, and why were the leaving the mainstream businesses to 'business as usual'? Were the exploring avenues, as the innovators, to be influencers?

In response to this, Builder A shared what he called the 80/20 impact, 80% of the impact that buildings have on the environment come from 20 key things. However, he said there was no perfect valuation or 'answer' with regard to any of these parameters, it is constantly evolving. How they arrive at the parameters is through the acronym CAFEET—Cost, Aesthetics, Functionality, Environment Friendliness, Ease of Construction and Time. Illustrating the idea of 'Environment Friendliness', he pointed out Environment friendly as per the IGBC parameter means something is sourced from within 200 miles (roughly 300 km), and addresses the social, economic, ecological parameters of sustainability by employing local people, adhering to Environmental Impact Assessment standards on waste generated, energy efficiency, water being minimal, air not being impacted etc. In contrast, their policy of opting for 'environment friendly' bamboo flooring to the extent possible, involved sourcing it from a region about 2000 km away, but ensuring that the vendor replaces the consumed resource (there is a cost involved, and growing bamboo sequesters more carbon than grown ones), as per their policies achieved the same objective. He reasoned that it also addresses the 'functionality' aspect—bamboo for a sturdy floor, as well as warmth/health for the feet in a cold climate, besides allowing for the growing of new bamboo.

Builder B has a multi-city presence in India and 16 mn sq ft of registered green building footprint by IGBC parameters. The key parameters include alternative building material (fly-ash replacing cement), energy-efficient lighting, water-efficient plumbing fixtures, rainwater harvesting, water recycling and re-use, organic waste treatment on site, maximising efficient day lighting and ventilation, and so on. Environmental sustainability through resource efficiency and by lowering the ecological footprint of their built-up areas once these were operational as well, were at the core of their strategy. Deeper ecological restoration pursuits and audits, such as for example through a baseline Biodiversity survey of the land prior to it being transformed into built area was admittedly ''so far not done''. The crux of their focus was rather on water, energy and material on site. The challenging of communicating to different groups of vendors in the supply chain was what was emphasised as the most challenging aspect in the enterprise. An annual contractors and suppliers meet was what Builder B, to their credit, had institutionalised to communicate parameters and priorities that they sought compliance for. Their focus was also in educating and communicating sustainable features in the operations to potential and actual owners of the properties through a 'resident assist' program

What both builders had in common include

1. Low water using taps and dual flushes
2. Sewage Treatment Plants
3. Treated (grey) water used for gardening
4. No concealed wiring or plumbing outside apartments to save material and cost, and also save on cost related to maintenance/repairs
5. Solar water heaters and panels in the high-end segment.

In the case of Builder B, it was yet another private initiative—that by the International Finance Corporation (IFC) of the World Bank Group, that roped them in for the cause of green infrastructure, through a consortium called the Sustainable Housing Leadership Consortium (SHLC). While the SHLC strategy of targeting the big players in appreciable, more needs to be done in the sector per se to convert several medium and small players, who's collective impact may be as big or even bigger. In this regard, it is noteworthy that the Indian Ministry of Environment Forests and Climate Change has partnered the IGBC to announce Government Incentives to IGBC green-rated buildings.

3 Some Thoughts to Conclude with

1. To better manage the knock-on effects to biodiversity and ecosystem services in Indian cities, a comprehensive and strongly decentralised and institutionalised understanding of why this is crucial has to be embedded within and owned by key government-run services and utilities, all housing infrastructure- related personnel (starting from planning and design schools to staff on site), and citizens alike. Awareness raising and enforced compliance/accountable role execution are key in order for this to come about.
2. As the SWM situation shows, ensuring improved and efficient fiscal decentralisation, capacity building, greater transparency in local government functioning, especially in the provision of public services; and institutionalising third party monitoring and stronger citizen engagement are imperative for Indian cities.
3. The case of the real-estate housing sector makes the case for educating and moulding consumer choices through the supply of the right kind of options. Large scale developments are increasingly managing waste, water and energy on their premises better and are helping citizens assume responsibility and take pride in doing their part as well. Making it the only choice as against an option, would be the next step. At the same time, policy that checks ownership of multiple homes is worth considering as well.
4. The allocation of business in government often leads to the challenge of a common turf failing to be understood and appreciated as one. That Solid Waste Management or Urban Infrastructure and Governance warrant the attention of the Ministry of Environment when these fall under the charge of the Ministry of

Urban Development, necessitates greater inter-ministerial coordination. Informed, inspired and influential bureaucratic leadership is imperative to drive the process of collaborative action forward, whether with regard to ensuring adequate financing, capacity building and institutionalised frameworks for accountability.

5. Finally, while the IPBES_CF makes the case for 'valuing' of ecosystem services, the challenge in the Indian context is that, when pitted against their alternative uses/replacement with human-made infrastructure (as seen in the case of vanishing wetlands of Chennai and Bengaluru) and wealth-creation opportunities (even when these are short-sighted, or beset with ecological risks) they lose out. Lack of adequate information and information flows (i.e.: science to inform policy) as against informed choice that undervalues the ecological for economic ends, is what the framework problematizes. The real challenge for the IPBES_CF and all the other work of the body to serve the ends of the triple bottom line of ecology, economy and society, therefore remains. Relevant regional and global partnerships for technical and scientific know-how for green infrastructure that achieves that bottom line, is perhaps what India, and other developing and emerging economies, need to seek from the platform.

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Healthy Cities, Healthy Settings and Education: How Do They Work Together to Promote Sustainable Development?

Maria Cristina Franceschini, Elisabete Agrela de Andrade and Karina Cimmino

Abstract The creation of healthy cities and settings is at the basis of many health models, is considered a fundamental element for sustainable development, and is one of the best known and successful health promotion strategies. Taking as a starting point the broader concept of health that shifts from the dichotomy of health-disease and considers that the production of health can take place in any space where there is life, this chapter aims to reflect upon the production of healthy and sustainable cities and settings that consider at its core, the subjects that circulate within these spaces. The chapter discusses some of the existing agendas for the development of healthy cities and settings, as proposed by WHO and considers the salutogenic model as an option to promote a paradigm shift in the direction of models that produce life and health at the territorial level. The chapter then reflects upon the role that education can play in the development of healthy and sustainable settings and how education can contribute as an emancipatory, health-promoting practice to sustainable development, pointing to some of the connections that need to be constructed within a context of multiple fragmentations of concepts, agendas, sectors, values and power.

Keywords Health promotion · Environment · Subjectivity · Healthy city Education

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1 Introduction

Citing Marco Polo, Italo Calvino's closes his book, 'Invisible Cities' with a warning:

> The inferno of the living is not something that will be; if there is one, it is what is already here, the inferno where we live every day, that we form by being together. There are two ways to escape suffering it. The first is easy for many: accept the inferno and become such a part of it that you can no longer see it. The second is risky and demands constant vigilance and apprehension: seek and learn to recognize who and what, in the midst of inferno, are not inferno, then make them endure, give them space. (Calvino 1990, p. 150)

This chapter will reflect upon what spaces, in the midst of the chaos of the cities, could potentially produce sustainable and transformative ways of life. The discussion will be based on the assumptions that the creation of settings[1] that support and promote the people and that allow for the integration of a variety of actors and sectors are key to identify these spaces, which are often invisible and, that there is great potential for the social production of health within any organization or community, considering that any policy that apply to these spaces can have implications for the health and wellbeing of those who there live.

In this analysis, the concept of 'territory' will be understood as the space that allows for the emersion of the people and the production of new meanings and ways to deal with collective and subjective issues.

This chapter will discuss if it is possible to bring these spaces to light, taking education as a pillar capable of contributing to the emergence of new forms of life. In other words, the goal is to reflect upon how education can contribute to the construction of spaces in the city that can be health-promoting, sustainable and transformative.

The chapter will consider the interrelation and interdependence between the concepts of healthy settings and sustainable development and will reflect upon how these settings (from a 'territorial' perspective) could contribute to the development of healthy and sustainable cities and communities. Considering the central importance of education in the generation of healthy and sustainable cities, emphasis will

[1]It is important to note that certain terms, concepts and terminology do not maintain their coherence when translated. In fact, they may be ambiguous when applied to a different language. One example is the concept of 'setting'. In Spanish, it implies environment and context. In Portuguese, it carries another meaning, more closely related to the idea of surroundings and geographical space, or of a territory adjacent to a population, such as a neighborhood. In English, the term is mostly related to the idea of environment. Therefore the term 'healthy settings', as proposed by the World Health Organization, makes more sense in English or Spanish. In Portuguese, in order to approximate the term conceptually to this idea of 'healthy settings', the best terminology would be 'healthy environments' or 'healthy spaces'. The term 'territory' is another example. In Portuguese it is understood as the environment or space in which subjects circulate, physically or subjectively. In Spanish or in English it is understood more as a geographical area. It is important to point out these different comprehensions of the same concepts as they may cause some discomfort to researchers in the field.

be placed in analyzing questions such as: do any educational activity promoted within healthy settings contribute to achieving the objectives of healthy and sustainable communities? What kind of education should be implemented in order to generate healthy and sustainable settings, communities and cities?

2 Settings, Cities, Territories, Subjects: What Spaces Are We Talking About?

As indicated in the introduction, for Calvino the city is not a simple geographical space, but a complex and inexhaustible symbol of human existence. Through this perspective, the city is constituted of the daily encounters of its inhabitants; whether it will be a city with possibilities for life, will depend on the way in which one accepts passively its challenges or is open to the possibility that something new may emerge. To trigger these possibilities, the author recommends continuous awareness and learning. Based on this provocation, we set out to reflect upon what scenarios could support such awareness and learning. How can education contribute and finally how has this discussion been approached worldwide and how we can be more proactive in the establishment of healthy and sustainable cities and communities.

The city needs to be considered as a human creation, a place where social contradictions manifest themselves and that brings to light the relations between the public sphere and the different groups that compose it. The city is a collective work of art, since it is not only the result of what is instituted and organized, but also of what is carved and appropriated by its occupants. Each group that occupies the city imprints on it its demands, its ethics and its aesthetics. With the arrival of industrialization, the notion of urban city, with its diversity of signs, emerges as a new concept, bringing out the notion of political space (Frayze-Pereira 1998).

Based in Henri Lefebvre, the Frayze-Pereira (1998) discusses how, in order to understand the city, one needs to consider its territory as political and strategic scenarios. The city is formed and shaped by historical, natural and political elements; its characteristics are conformed by how it is organized and occupied. In this sense, the approach used in the construction of the city, should take as its object, those who occupy and use this space.

The concept of territory is understood as a realm for the emergence of subjects, where meanings are produced and new ways of dealing with subjective and collective issues arise. The territory is also the arena in which different forces co-live in the pursuit of its development. When an intervention proposal emanates from the territory itself, it has the potential to be enriched by the participation of its own subjects, which can help to guarantee good governance and promote the sustainability of actions aimed at improving the quality of life of these same subjects (Sacardo and Gonçalves 2007).

According to the authors of this chapter, an intervention proposal that considers the primacy of the territory and recognizes the potential that arises from it, constitutes a step forward in strengthening public policies because it invests in the notion of power of the subjects. Creating possibilities for encounters among subjects to take place, particularly in the public sphere, would be a potent strategy for the production of life.

The creation of spaces that empower the individuals and that enable the integration of different actors and/or sectors, is the focus of work for those who seek to build healthy settings. Although it is not always visible, there is potential for the production of health in practically every organization or community and, to the extent that policies are implemented in these spaces, they can have implications for the health and well-being of those living there.

Any intervention that takes place in a territory and that strengthens its actors, can foment the construction of health-promoting environments. Among the diversity of possibilities within the complexity of any given territory, the field of Education assumes fundamental importance, since it can promote dialogue, respect for diversity and the establishment of trust, thus enabling the emancipation of the subjects.

The remaining of this chapter will discuss some of the models proposed for the creation of healthy settings and reflect upon how, through the lenses of the 'territory' and its subjects, the settings approach can be revisited and the concepts of education and educational settings can act as a catalyst for the production of health.

3 Healthy Cities and Settings: What Are the Models and Approaches?

Health can be produced in any and all spaces in which there is life (Antonovsky 1988). This is a core principle of the settings approach. Every setting—be it an organization, a school, a community, a city, a prison, a hospital, etc.—can potentially promote health and well-being. This potential for the production of health can be mobilized and catalyzed through actions, strategies and policies that are developed taking into account the contexts and characteristics of these settings as well as that of the people who there live and interact.

The creation of healthy settings is at the heart of many models of health and is one of the best known and successful health promotion strategies. The Ottawa Charter recognizes that "the inextricable links between people and their environment constitutes the basis for a socioecological approach to health." It also states that "health is created and lived by people within the settings of their everyday life, where they learn, work, play and love" (WHO 1986). Since the publication of the Ottawa Charter, every major WHO Global Health Promotion Conference has emphasized the need to develop healthy public policies as a mean to foster supportive and sustainable settings.

The settings approach remain highly relevant to the health promotion and sustainability agenda. More recently, the healthy settings approach has been highlighted as a key component on sustainable development agendas, such as Agenda 21, Millennium Development Goals and Sustainable Development Goals. The latest WHO Global Health Promotion Conference that took place in Shanghai in 2016 emphasized the importance of local governance and healthy cities not only as a means for better health but also for achieving social justice, equity and sustainable development.

Sustainability and healthy cities and settings are considered inherently linked. Sustainable environments are key for development, which in turn is linked to improvements in quality of life of individuals and communities. Social justice and community participation are also shared values for Agenda 21 and the SDGs agenda, health promotion and healthy settings approaches.

Many models have been proposed for the development of healthy cities and settings. The best-known and applied worldwide are those spearheaded by the World Health Organization: Healthy Cities and Healthy Settings strategies. We will take these models as the starting point for this discussion, however, it is important to point out that they are not without controversy and that other models, such as salutogenesis and health assets offer important alternatives to the WHO models. These other models will be briefly presented here, although it is not the goal of this chapter to promote an in-depth reflection and comparison of these models.

The World Health Organization defines a setting as "the place or social context in which people engage in daily activities, and in which environmental, organizational, and personal factors interact to affect health and wellbeing" (WHO 1988). Based on this conceptualization, a setting can be a physical space as well as a social dimension. It can be a space with physical boundaries and organizational structures, in which people play specific roles—such as a school, a hospital, a university or a workplace. It can also be a place where people interact and live their daily lives, such as a community, village or a city. Finally, a setting could be defined in terms of issues that are common to specific groups of people or to phases of life—children, youth, elderly, aging, etc.—and consider the contexts and places where these issues develop or that these groups occupy.

The Healthy Settings, or "setting-based approaches" propose to focus on these settings through a holistic, systemic and multi-disciplinary perspective and to consider what actions can be taken in order for them to support and promote health and quality of life. Healthy settings approaches are also often characterized by a concern with integration, interrelation and interdependency among various elements as well as with the wider, broader context, environment and other settings.

Healthy settings initiatives can act at various levels and through different strategies. Some involve promoting changes to the physical environment or organizational structures (such as building appropriate infrastructure or changing management practices). Other initiatives can aim at mobilizing and empowering individuals and communities to promote broader social change, such as through the creation of healthy cities or communities.

The Healthy Cities movement is one of the best-known example of a healthy settings approach. Initiated in Europe in 1986, it rapidly spread across the world. In the American continent, the movement adapted to the regional geopolitical and cultural context, and is known as the Healthy Municipalities, Cities and Communities Initiative.

According to WHO, "a healthy city is one that is continually creating and improving those physical and social environments and expanding those community resources which enable people to mutually support each other in performing all the functions of life and developing to their maximum potential." The movement is firmly based on the principles of community participation and empowerment, intersectoral partnerships, and the promotion of equity. It places great emphasis on coordinated actions lead by local decision makers and civil society aimed at promoting comprehensive strategies for health promotion and sustainable development at the local level. So, rather than focusing on specific settings, a Healthy City promotes a long-term commitment to improve the city's social, political, physical and economic environment as a whole.

Healthy Cities and healthy settings, although often presented as separate strategies (and often implemented as such), are conceptually linked and should be thought of as part of the same model for the production of health. The construction of healthy settings within a city or municipality (such as healthy schools, healthy workplaces, healthy housing, etc.) should not be understood as the main goal, in and of themselves, of a healthy setting strategy. It is key that the creation of these settings are planned and implemented in an integrated manner, as part of an overarching and broader strategy, linked to the vision and plan for a Healthy City.

Countries worldwide have adopted and applied Healthy Cities and other settings-based approaches as a means to achieve better health. Sometimes these initiatives are implemented as part of a holistic health promotion strategy and consider the integration and continuity of settings across the spectrum of people's and communities lives. Yet, it is often the case as well in which settings initiatives are fragmented and implemented in isolation, missing out on the opportunity to maximize their potential and harness the value of the cross-cutting contributions that working on various settings simultaneously could have to health.

Even though healthy settings approaches have been discussed and implemented worldwide for decades, there is little consensus about either their theory or practice (Dooris 2004). Some of the challenges include a wide breadth of conceptual understandings, the diversity of practices developed in different contexts and the complexity of analyzing experiences that apply a whole system, integrated and ecological approach (Dooris 2004, 2006).

As a result, the evidence base of the effectiveness of healthy settings approaches is poorly developed (Dooris 2006). Most of the evaluation studies conducted have focused on individual settings projects. Little is known about the synergies of working with settings initiatives in a coordinated manner. Policymakers and practitioners also struggle with how to coordinate these initiatives in order to promote and build upon their full potential across various settings.

Another way to reflect upon the settings approaches would be to look at them through the perspective of those living and transitioning through these spaces, their relationship to these settings and the meanings they create as part of these experiences. The concept of "territory", as discussed above, can serve as a basis to reflect upon and connect settings-based strategies and catalyze action towards greater social production of health as a whole. Understanding "settings" through the lenses of the "territory" can serve as a methodological starting point for the development of interventions that are more aligned with people's and communities desires, expectations and potentials, and as such, generate personal and social development that is more meaningful and relevant for those whose lives are affected by such actions.

How to healthy settings initiatives take into account the singularities of the territory and of the subjects who there live? It is enough to change environments without considering the singularities of the lives and of the individuals that circulate in these spaces? How do healthy settings contribute to the construction of capacities, competencies and to create possibilities for social transformation that is catalyzed from the people and their context of life?

These are important questions that have been approached differently by other models that focus on how life and health are produced among groups of people and within cities and communities. One of the most discussed in the public health field is the theory of salutogenesis, which emphasizes the importance of understanding what produces health instead of what produces disease. The concept of salutogenesis, proposed by Aaron Antonovsky has been around since the 1970 (Antonovsky 1988). Antonovsky set out to answer one simple question: what creates health? The answer gave rise to a new theory and model that understands health as a positive concept. A key pillar of the salutogenic model is the concept of health assets, which refers to the resources—of individuals, families, communities, populations—that empower them to seek, produce and maintain health and wellbeing (Juvinya-Canal 2013).

The adoption of a salutogenic model for the development of public health interventions requires the application of new lenses to populations and communities. Instead of assessments and diagnosis of needs and health problems, a salutogenic approach would focus on identifying the health assets present in any group or community and recognizing their strengths, capacities, experiences and interests. In other words, it would focus on recognizing and giving visibility to the singularity of people's lives, their potential as well as that of their settings and territories.

Not much is known about the potential of the salutogenic model of health. Challenges include a weak evidence base, lack of comparative studies, no clear definition of what is a public health asset, and a lack of understanding of the sinergies and strengths of the application of this model (Eriksson and Lindstrom 2005; Santos et al. 2011; Álvarez-Dardet and Ruiz Cantero 2011). Advancing the practice of salutogenic models of health remains an important challenge for health promotion and community public health. In addition to understanding the key theoretical pillars related to how people experience life and health and how a salutogenic model can empower populations, it is important to understand how such model can guide professional practices, services and political action

(Álvarez-Dardet and Ruiz Cantero 2011). The salutogenic model offers an interesting and much needed possibility for a paradigm shift towards a more empowering and transformative way to understand how life and health are produced in the context and settings of daily life and how to positively influence them.

4 The Role of Education in the Development of Healthy and Sustainable Settings

Considering Calvino's discussion of 'invisible cities', this section will discuss how education can contribute to the challenge that implies to recognize within cities, 'the who and the what are not the inferno', and not only strengthen it but allow it to reach its full potential. Along this line, we will discuss how education has a crucial role in allowing subjects to identify and catalyze aspects related to health within their daily settings and territories. As such, education can contribute to the generation of healthy and sustainable settings and cities.

Our starting point will be the definition of education. According to Paulo Freire: "true education is praxis, reflection and action of mankind over the world to transform it" (Freire 1970, p. 3):

> According to this definition, the person is thought of as a historical and social being able to transform his/her community/surrounding. At the same time, the social context and culture are considered as something dynamic and heterogenic. In this sense, education could contribute to the formation of critical and reflective competences and capacities of subjects to analyze his/her realities and transform them. (Freire 1970)

Education has also a central role in the promotion of human development. According to the sociocultural learning theory (Vygotsky 1977) learning/education precedes development of the subject. Through formal and informal educational processes, the 'other' (represented by more experienced people or the culture) transfer beliefs and knowledge that contribute to accelerate and to shape internal processes related to the development of subjects.

Therefore, it is understood that the intentional design of quality educational experiences within the various settings (cities, schools, hospitals, prisons, housings, communities, etc.), can contribute to the overall psychosocial development of people. At the same time, these educational experiences embedded in various settings can allow subjects to more clearly identify, create and recreate healthier settings. As a result, education, healthy settings and development are intimately and sinergistically linked.

Human development should be understood as the broadening of people's capacities and freedom. The goal of development should be to improve human lives, opening the scope of possibilities of things people can be and do (Arriola-Quan 2007). From this perspective, the fundamental contribution of human development is that people have freedom and opportunities within their social settings and that they can use them to live the life they what and be the person they

would like to be. This is the bridge that connects healthy settings and human development: healthy settings should generate these opportunities for people to fully develop and reach their potential within the various setting in which they transition along their life course.

Education also plays an important role in the construction of competencies and capacities of the subjects to be able to participate and to identify the most determining factors that affect health and to carry out individual and collective actions to transform them.

As such, education is also a tool to facilitate sustainable development as it allow each human being to acquire knowledge, competencies, behaviors and values needed to build and maintain sustainable settings. According to UNESCO (2014), to educate for development means to incorporate fundamental issues related to development within teaching and learning. This requires the use of participatory teaching and learning methods that motivate people and promote autonomy and capacities to create and adopt measures for sustainable development.

Additionally, education is key for the emergence and development of subjectivities. As previously discussed the concept of territory refers to the space that allows for the emergence of subjectivities and of power conflicts among subjects. This means that educational strategies within territories and settings should help to develop, give voice and space for these subjectivities that otherwise will remain hidden and silenced by social, economic and cultural inequities.

Returning to Calvino's invisible cities and thinking about education and today's context, Tedesco (2008) considers that in the new capitalism, the dominant speech aims to satisfy demands. Citizens are conceptualized as clients or as social service users. It could be said that today there are, in theory, more possibilities to choose than at any other historical moments; however, each one gets what he or she is able to demand.

> That is today's situation paradox: on the one hand, these mechanisms effectively expand my capacity of choosing, I have much more leeway to choose, I can build my identity much more freely, but, as this is accompanied by big inequalities, exclusion and fragmentation, it turns out that if everything is subjected to my capacity of demanding, I get only what I am in condition of asking and not what I need. It is very important to point out the difference between satisfying demands and satisfying needs. For vast sectors of the population, especially those that live under unfavorable conditions, there are needs that cannot be expressed as demands. The leap between one dimension and the other implies a big capacity of expression and organization (Tedesco 2008, p. 53).

Along these lines, educational strategies within the various setting and territories can contribute to the development of capacities of the subjects so they can translate their needs in demands and, as a result, achieve real participation in the design of strategies that have as a goal the promotion of their health and their individual and collective development.

The author also points out to the need to recognize the right to subjectivity and to promote it through education. "We all have the right of being subjects and to be allowed to develop our subjectivity, our capacity of choosing, our capacity of opting, our capacity of building our identity. Exclusion implies, among other

things, the absence of the possibility of defining a life project…projecting yourself into the future implies knowing yourself, knowing what I want, what I like, what I want to do. Then, this right of having a future, the right to subjectivity, is a right that turns to be essential" (Tedesco 2008, p. 58).

In this sense, this author highlights that an education that facilitates the construction of subjectivities should consider: trust on people's learning capacity, the importance of a pedagogy oriented towards strengthening people's capacity to define his/her life project and the centrality of a teaching that strengthens the ability to narrate and to express what is going on. "Pedagogical strategies based on strengthening people's self-esteem, the capacity of knowing themselves and to narratively articulate his/her desires, demands and needs, decisively contribute to form subjects and not mere repeaters of information" (Tedesco 2008, p. 63).

Finally, as we recognize the need for education to generate healthy and sustainable environments, it is important to rethink and analyze what it is understood by education in healthy cities and to reflect about what type of education is needed for this purpose.

Even though the Ottawa Charter of 1986 considers a holistic approach to health education, in many cases, the health education experiences in healthy settings are focus mainly on promoting changes in people's behavior and lifestyle (Cimmino et al. 2016). In these cases, it is implicitly presumed that educational activities will result into people adopting behavior and lifestyle "considered healthy". From this perspective, the education offered has often been prescriptive and normative, since it has focused on giving out information and contents about what should or should not be done to be/stay "healthy" (Tones 1986).

As mentioned throughout this chapter, we consider that if education is to adequately accomplish its role in the construction of subjectivities and healthy and sustainable cities, it should consider people's context and knowledge, promote participation, horizontal dialogue, empowerment, and the development of psychosocial competences that stimulate critical and reflexive thinking and that allow for people to choose and adopt behaviors that favor their health and that of their communities.

5 Conclusion

From literature to philosophy, there is a common thread that cities should be understood as the product of the complex interactions among ecological, subjective, political, cultural and social factors. Following this line of thinking, the field of collective health and the healthy municipalities and cities movement that since the 1980s has spearheaded the discussions about 'healthy settings', has put forward a conceptualization of health that is complex and not limited to the relationship between health and disease.

This chapter aimed to promote a reflection about the basis upon which efforts to create healthy settings are built and bring to light the importance incorporating the

notion of 'territories' and subjectivities into this framework. It also aimed to reinforce the centrality of education as an essential tool to improve quality of life. However, education in this sense should not be understood as 'the savior from all evils' or as the field responsible for educational activities to sanitize society. Education should be understood as an emancipatory practice that promotes the autonomy of the subjects.

When education is committed to contribute to the creation of healthy and sustainable cities and settings, it will also be committed to the creation of scenarios that promote life. The creation of these scenarios will only be possible when the reality of each territory is taken into account, along with the meanings and relations that are built by those who inhabit it. The complex reality of any given territory constitutes a living realm that is under permanent construction and which goes beyond its objective conditions, bringing with it also a subjective dimension that result from the relationships established among its subjects.

Currently, many models are proposed for the development and planning of cities and settings; these are often based on different notions of what cities and city life should be like in the twenty-first century. Besides the WHO Healthy Cities and Healthy Settings strategies, other examples include Sustainable Cities, Resilient Cities, Compact Cities, Smart Cities, and so on. These various models carry their own agendas and are based on various notions of citizenship and subjects. They dispute, sometimes different and sometimes overlapping spaces, territories and powers within cities and population groups. As cities throughout the world seek for ways to be sustainable while placing the wellbeing and the potential of their subjects at the center of their development, some of the questions for these models would be: can these agendas (strategies/models) help to uncover and to recognize the who and what, "in the middle of the inferno, is not inferno, then make them endure, give them space"? Do they contribute to the construction of cities that support the production of life? How do they help us see beyond the "inferno" of the city? These are complex questions and their answer require building connections within a context of multiple fragmentations composed of concepts, agendas, sectors, values and power.

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Education for Sustainability as a Tool to Promote Sustainable Development: An Experience in the South of Brazil

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Abstract Governance can be understood as the decentralization of management, allowing to the population to act in the direction of financial resources, the project proposal and oversight of public services. Citizens become the focus of the planning of public policies, helping to identify local problems and potentialities. However, despite the increase of the participation channels, few social actors feel motivated to participate due to lack of individual empowerment. The aim of this research was to train citizens in education for sustainability, intending to make them more involved in their communities. The research was conducted in three cities of Rio Grande do Sul (Passo Fundo, Porto Alegre and Santa Maria), using the method of focus groups applied in the monthly meetings. As a result of the research identified that few citizens know important participatory channels, such as "State Popular Consultation". Moreover, even the acting individuals in Associations of Residents and non-governmental organizations are not empowered enough to participate in municipal councils Deliberative, Public Hearings, courses and training projects. The inclusion of education for sustainability in the communities should be promoted so that the social actors know the importance of their actions and recognize their potential for change. After the research, some individuals felt empowered and promoted actions in their neighborhoods, thus becoming local stakeholders. It's clear that greater efforts and capacitation projects in sustainability education will be needed to promote citizen empowerment and potentiate local governance.

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1 Introduction

Power decentralization promoted by governance contribute for the improvement of public management, increasing its efficiency mainly in monitoring and verifying compliance with proposed goals and projects, and may even reduce costs through the allocation of local capacities, thus strengthening the community. This is why their participation favors the identification of local needs and the proposition of strategies to solve them, since the interaction between different social actors allows cooperation and mobilization towards a common goal. This participatory governance model tends to become more efficient when the management decentralization (bottom-up model) and the empowerment of local community organizations occur concomitantly, thus creating social capital (United Nations 2008).

Thus, it can be affirmed that participatory governance has as its characteristic elements: social participation, the opening of participatory channels within public management and the strengthening of these channels in order to create trust in the seriousness of their propositions. This governance model seeks participation as strengthening citizenship, as it enables citizens to become better informed and empowered in to political action (empowerment) (Lüchmann 2012).

So, projects promoting the improvement quality of life tend to form socially active citizens who are essential for the promotion of sustainable societies. It is in this context that education for sustainability emerges, based on awareness, change of habits, improvement of skills, interdisciplinary formation and participation of all. Its implementation aims to empower the citizen as a change agent in the search for their society's sustainable development. It is, therefore, a tool for promoting learning, communication and "building capacities" for sustainable development (Jacobi 2004; Merino and Carmenado 2012; Sachs 2002).

The process known as "building capacities" is related to an addition to the specific knowledge already acquired by the individual. The approach presented here refers to the Micro level based on the strengthening of individual skills, education, ethics, moral values and social matters. "Building capacities" is important because it aim to promote intercultural dialogue, the valorisation of local culture and respect for diversity, with focus on local needs, in order to identify problems and the potentialities perceived by the community (Buarque 2006; Thomas and Day 2014).

It is important to emphasize that "building capacities" has as its central element the learning that promotes the self-esteem and confidence of the participants (Thomas and Day 2014). This trust translated into empowerment that fosters engagement for social transformation by the power claim by the minority groups wich been until then excluded from society (Freire and Shor 1986). Thus, participation is directly related to empowerment, since the presence of ordinary people in

the decision-making process may influence their results, even if this participation is not yet equal to elite decision makers (United Nations 2008).

Empowerment definition is complex and can vary according to social, national and cultural context, for example, it may be a goal for development projects or a process that drives people to the change. It is important to emphasize that empowerment can have four components: cognitive, psychological, economic and political (Medel-Anonuevo 1995), in this research we focus on the political component, since it involves individual and collective awareness towards a common goal.

Thus, the United Nations (2008) states that empowerment allows people to have more control over decisions that influence their lives, thus impacting their improvement. Therefore, it can be conceptualized as power delegation, which occurs through building capacities, access to information, participation, self-responsibility, self-valorization, freedom of choice, promotion of shared leadership and lifelong learning (Chiavenato 2014).

The biggest difficulty in promoting "building capacities" and empowerment projects is the mobilization and the sensitization of social actors in order to aggregate committed participants, since participation is reduced and inconstant, even in participatory channels already established (Zanin 2013). That is why, this research aimed to empower citizens in education for sustainability, aiming to make them more participatory in their communities.

2 Materials and Methods

2.1 Study Area

The study was developed in the State of Rio Grande do Sul (RS), which is located in the southern portion of Brazil, bordering Uruguay and Argentina, in its southern and western part, with the Atlantic Ocean in the eastern part and, with the State of Santa Catarina to the north.

This research is part of a larger project entitled Pre-Requisites for the Sustainability of the Municipalities of Rio Grande do Sul (PreSust-RS). Therefore, the study was developed in the cities of Passo Fundo, Porto Alegre and Santa Maria, where are located PreSust-RS partner universities: University of Passo Fundo (UPF), Federal University of Rio Grande do Sul (UFRGS) and Federal University of Santa Maria (UFSM), respectively. In addition to the University of Hamburg in Germany (HAW). Besides that, the study cities are regional poles and, being among the largest populations in the state.

2.2 Methodology

This research is qualitative, exploratory and descriptive, based on the collective case study with uncontrolled variables and without a static sampling unit, since the stakeholders participating modified the results throughout the research (Flick 2009; Gerhardt and Silveira 2009; Yin 2015).

As a method for awareness and empowering the participants, the focus groups methodology was used to promote discussions about themes, allowing the sharing of moral values, behaviours and experiences (Barbour 2009). These manifestations were added to the technical aspects introduced by the mediator and, to improve the application of the method, the research was conducted with the help of a co-author.

The research was developed from July to December 2015, with six meetings in each studied city, totalizing eighteen training meetings. The meetings had an average duration of 2 h. The methodology is summarized in Table 1.

The identification of the stakeholders occurred through previous meetings organized in the cities of study, in which non-governmental organizations, civil society entities and public agencies were contacted, questioning them about whose would be the local stakeholders, inviting them to become partner entities. The identified persons were then invited to participate in the Stakeholder Mobilization step. All the participants in this survey were called stakeholders because we supposed they would be to able to impact their local environment through their actions. Although all the intense previous work, the number of participants varied according to the research stage and the worked city (Table 2).

The application of "Pre" and "Post-Test" was intended to evaluate the aggregate knowledge or change of opinion/behavior due to the individual's participation in the training. The Participatory Channels addressed in the questionnaires were: "Aundiência Pública" (Public Hearing), "Orçamento Participativo" (Participatory Budget) and "Consulta Popular Estadual" (State Popular Consultation). The questions sought to identify whether the respondent had already participated, what was the justification for their response and if they had knowledge of the tool called

Table 1 Synthesis of methodological steps and research activities

Research Step	Developed Actions
Stakeholder Mobilization	A meeting at which the survey was presented. Those interested in participating answered the "Pre-Test" questionnaire
Stakeholder Capacitation	Three meetings using the "focus groups" method to discuss local issues related to sustainability, emphasizing the importance of citizen participation, citing and exemplifying participatory management channels
Stakeholder Awareness	A meeting in which stakeholders made their observations about the survey and completed the "Post-Test" questionnaire
Closing	A meeting for the delivery of the participation certificates

Source Tiepo (2016)

Table 2 Identification of the number of participants in each step of the research

Research step	City	Number of participants
Stakeholder mobilization	Passo Fundo	06
	Santa Maria	18
	Porto Alegre	08
Stakeholder capacitation (first meeting)	Passo Fundo	03
	Santa Maria	09
	Porto Alegre	05
Stakeholder capacitation (second meeting)	Passo Fundo	03
	Santa Maria	14
	Porto Alegre	05
Stakeholder capacitation (second meeting)	Passo Fundo	07
	Santa Maria	12
	Porto Alegre	05
Stakeholder awareness	Passo Fundo	04
	Santa Maria	11
	Porto Alegre	05
Closing	Passo Fundo	03
	Santa Maria	10
	Porto Alegre	05

Source Tiepo (2016)

Participatory Budgeting, also questioning if it was important and what the reasons for its importance.

3 Results and Discussion

3.1 Formation of Focus Groups

The formation of the focus groups was distinct in the three study areas, the Passo Fundo group, despite being smaller (only three participants), presented the highest level of education, being all the members with a graduated course, some with post-graduated (Master, Doctorate) which facilitated the interaction and the debate. The meetings of this group took place in the central area of the city, easily accessible, including served by public transportation.

The focus group of Porto Alegre had an average of five participants, most of them with technical schooling, composed mainly of men. The age of the participants was between 46 and 60 years old. In this city, the meetings were held in the premises of the NGO Solidariedade, an entity that became a partner of the research.

In Santa Maria, there was a predominance of women, however it had the lowest schooling rate (elementary school, high school) compared to the other groups.

As for the age group, the majority of participants also ranged between 46 and 60 years. This was the group with the largest number of participants, an average of twelve per session, however it had an high alternation between the members, which made difficult the process of building capacities. This group was meeting in the Campestre do Menino Deus Neighbourhood Residents Association, another entity partner.

Thus, it is assumed that the partner entities acted as local articulators of the focus groups, giving credibility to the proposed initiative, corroborating with what has been observed by Buarque (2006), who affirms that the awareness of the invited actors is essential for their effective participation. In this way, as in the Passo Fundo group there was no articulator, the participation was smaller.

3.2 Pre-Test Analysis

In the three studied cities, twenty-seven completed questionnaires were obtained, six in Passo Fundo, eight in Porto Alegre and thirteen in Santa Maria. Next the results are presented according to the studied city and tool analyzed.

3.2.1 Public Hearing

The Public Hearing can be conceptualized as a mechanism of participation in the decision-making process, with a presential and consultative character, that allows the interaction between different social actors, through the oral manifestation of the participants. This debate, in addition to transparency, gives legitimacy to public management, facilitating the problem solving and minimizing social conflicts (César 2011).

In Passo Fundo, four respondents (66.66%) reported having participated in some Public Hearing; those who did not participate (two respondents) justified as follows:

> Lack of opportunity (Extracted from the Focal Group, Passo Fundo, 2015).
>
> (…) Usually there is little disclosure and very close to the date of the event (…) (Extracted from the Focal Group, Passo Fundo, 2015).

By the justification, even those who had not participated knew the tool of participatory management and recognized its importance.

In the study area of Porto Alegre, the eight respondents (100%) stated that they had already participated in a Public Hearing, even reporting that the NGO Solidariedade had been the site of one that dealt with the delimitation of neighbourhoods. This pattern of behaviour seemed to be related to the profile of the participants, as some had experience, including as Delegates of the Participatory Budget of Porto Alegre and members of the World Social Forum.

In the Santa Maria focus group, only four people (30.76%) had already participated in a Public Hearing. Of those who had not participated (nine respondents), only two justified:

> Lack of disclosure (Extracted from the Focal Group, Santa Maria, 2015).
>
> Lack of interest in politics (Extracted from the Focal Group, Santa Maria, 2015).

Thus, one of the justifications corroborated what had been affirmed by the focus group of Passo Fundo.

We highlight that out of a total of twenty-seven people surveyed, sixteen (59.26%) had already participated in at least one Public Hearing. This percentage can be considered low, considering that this instrument of participation is foreseen in the Brazilian Federal Constitution of 1988 showing the need to promote citizen empowerment.

3.2.2 Participatory Budget

The Participative Budget was created in Porto Alegre in 1989, allowing the population to decide in which demands the public money should be invested. It is a worldwide reference for the empowerment of the citizen, through the feeling of belonging, favouring the control of the governmental spheres and the reduction of corruption (Conselhos Regionais de Desenvolvimento 2014).

In the Passo Fundo group, all (100%) knew and acknowledged the importance of this tool. The more detailed definition of the group was thus described:

> Yes. It is very important, because it uses the participation of the population that brings the demands and problems, helping in its resolution and choosing where to invest the public resource (Extracted from the Focal Group, Passo Fundo, 2015).

In the case of Porto Alegre, as expected, all (100%) had knowledge about the Participatory Budget. Besides that, one of the participants answered:

> Yes, I am one of those who created the PB in the city of Porto Alegre. It is important because it reverses priorities and gives the citizen a leading role (Extracted from the Focal Group, Porto Alegre, 2015).

However one of the participants expressed discontent:

> The budget when it started was very important because the city planning was approved by the PB. Today this is no longer the case (Extracted from the Focal Group, Porto Alegre, 2015).

While in Santa Maria, only five participants (38.46%) knew this channel of popular participation. Even a retired military man who was responsible of a non-governmental organization (NGO) said that such a tool did not exist in Santa Maria.

This statement may be related to the lack of publication and the low rate of completion of demands proposed in the Participatory Budget leding to the idea that

in the city there is no this participatory process. It is therefore the responsibility of the Municipal Administration to systematize data and to disseminate it in an appropriate manner to the population so that they become aware of the process to being more participatory, because both the management transparency and the inclusion of the community in decision-making processes are essential for the development of more sustainable and inclusive cities.

So, regarding this participatory management mechanism, of the twenty-seven participants, nineteen (70.37%) had knowledge on the subject. The lowest percentage was registered in the Santa Maria focus group, which was basically composed for residents and members of the Campestre do Menino Deus neighborhood, characterized as a low middle class with few basic infrastructure (public lighting, sidewalk, solid waste collection and sewage). At all meetings the participants reported their discontent with municipal public administrations and the lack of a sense of "belonging" which is essential for the empowerment of the individual. According to Tavares (2014), Critical Social Psychology already emphasizes that the inclusion of the individual in society and its consequent appreciation are part of the basic needs of the human being. On the contrary, this feeling of impossibility of participation translates into ethical-political suffering. It is important to emphasize that this research was the first Sustainability Education project developed in the locality.

3.2.3 State Popular Consultation

The State Popular Consultation was instituted in Rio Grande do Sul, in 1998, through Law 11179. In this case, it is also the population that defines a portion of the investments and services that will be inserted in the State Budget. Participation can occur both through the Regional Development Councils (COREDES) that promote Regional Public Hearings, Municipal Assemblies and Regional Forums, listing priority demands that will compose the specific regional ballot for each COREDE (Conselhos Regionais de Desenvolvimento 2014). As also by the annual vote, either by the printed ballot or in the online system.

In Passo Fundo, four members (66.66%) of the group had already voted at least once in the State Popular Consultation. One of the members who answered negatively to the question justified as:

> Lack of opportunity (Extracted from the Focal Group, Passo Fundo, 2015).

Concerning the focus group in Porto Alegre, only three members (37.5%) had already used this instrument of citizen participation. Similar to what happened in Passo Fundo, one of the stakeholders stated that:

> I did not get a chance (Extracted from the Focal Group, Porto Alegre, 2015).

This justification is worrisome, given that the voting date is published in the media (television broadcasters, radio and, printed newspapers) and, in most cases, by the municipal administrations themselves, as it may represent an increase in

resources. In addition, the online voting option would tend to facilitate access to the system.

In Santa Maria, four stakeholders (30.77%) stated that they had already voted in the State Popular Consultation, among those who had not voted, some justified that:

> There is not (Extracted from the Focal Group, Santa Maria, 2015).
>
> Lack of knowledge about it (Extracted from the Focal Group, Santa Maria, 2015).
>
> I do not know that directive (Extracted from the Focal Group, Santa Maria, 2015).

The same participant affirmed that there was no participatory budget in Santa Maria, as well as the State Popular Consultation. The other two respondents had higher education (in progress and completed, respectively). This unknowing of the potential of action of the individual in society makes evident the need to review the performance of the university in the community, since higher education institutions are spaces of free expression, where prevails creativity and the development of new knowledge, its impact can be even more important, in view of the student exchanges that come from the most varied countries (Moore 2005). Thus, the university must be a social actor of sustainable development, maintaining contact with different stakeholders through the nearness of the university with the community (Sachs 2002).

In summary, of the twenty-seven people analyzed, only eleven (40.74%) had already voted in the State Popular Consultation. This percentage was the lowest among the three management tools analyzed, this result was not expected because it is a State program widely disseminated in smaller municipalities, where any increase in resources is important.

3.3 Post-Test Analysis

The Post-Test questionnaire was applied in the fifth meeting of this research, after the Capacitation, to the stakeholders present. It should be noted that there was a decrease in the number of respondents in the three study areas, resulting in eighteen Post-Test questionnaires: being four in Passo Fundo, five in Porto Alegre and nine in Santa Maria. Of these eighteen, only ten had responded to the Pre-Test, corresponding to 37.04% of the initial twenty-seven participants, which made it difficult to analyze of the results.

3.3.1 Perception of Public Hearing After the Capacitation Stage

In the focus group of Passo Fundo, three members (50% of the initial group) answered the two questionnaires. In addition, a new entrant was admitted to the final phase of the research, which stated:

> The Capacitation in Education for Sustainability should continue in the following years, covering other cities besides Porto Alegre, Passo Fundo and Santa Maria. (Extracted from the Focal Group, Passo Fundo, 2015).

Regarding the Public Hearing, the three respondents (75%) had already participated, and one of the respondents changed their behaviour: at the beginning of the survey she reported the lack of disclosure and after the capacitation she answered that:

> Yes. Because, I was working directly with the subject (solid waste) (Extracted from the Focal Group, Passo Fundo, 2015).

This is because individuals tend to be more participatory when their interests are on the agenda because each will tend to influence the other in order to reach their priorities (Buarque 2006).

The negative response came from the member who joined the group after, so he emphasized the need to continue the research in subsequent years so that more people would be reached and had the opportunity to discuss local issues, adding knowledge and attitude change (Empowerment).

In Porto Alegre, the Passo Fundo pattern was repeated, that is, 50% of the group (four participants) remained and a new member joined the group. As for the Public Hearing there was no change, all (100%) had already participated, including the participant who joined the survey from the second meeting:

> Yes. I'm a community leader (Extracted from the Focal Group, Porto Alegre, 2015).

In Santa Maria were three members of the initial group (23.07%) and six new members being that only one new member (11.11%) had participated in a Public Hearing:

> Yes. Because I wanted to see what it was like (Extracted from the Focal Group, Santa Maria, 2015).

The others, even those who had participated in the capacitation did not change their behaviour. The justifications of the group (new and older members) were very similar:

> I did not know (Extracted from the Focal Group, Santa Maria, 2015).
>
> Because, I've never had a chance (Extracted from the Focal Group, Santa Maria, 2015).
>
> I've never been interested (Extracted from the Focal Group, Santa Maria, 2015).
>
> I have not had a chance yet (Extracted from the Focal Group, Santa Maria, 2015). (New member)

The results of Santa Maria were not very promising due to the high turnover among the members of the group. In addition, despite being an association that develops several activities in parallel, aiming the well being of the community, its members were unaware of the participatory management mechanisms at the city level. So, greater efforts and empowerment projects will need to be developed on the spot.

In conclusion, of the eighteen people analyzed, nine (50%) had already participated in a Public Hearing, a percentage lower than that obtained in the Pre-Test questionnaire (59.26%). This data denotes the difficulty of mobilizing participants to become present and active in society, corroborating with what Leal Filho and Brandli (2016) observed that identified a number of factors to which lack of participation may be related, one of them being the difficulty to maintain the interest of the individual to participate, since many stakeholders give up during the process.

That is why Zanin (2013) states that empowerment actions should be implemented in order to sensitize individuals to commit to the proposal, discussing, debating, questioning and interacting, thus becoming active and committed citizens.

3.3.2 Perception on Participatory Budget After the Capacitation

Regarding the Participatory Budget, there was no change; all (100%) members of the Passo Fundo focus group knew the tool, including the new member:

> Is in the public hearing, that the community budget is discussed with the community. It's very important, to the population to participate of these deliberations (Extracted from the Focal Group, Passo Fundo, 2015).

In Porto Alegre also all (100%) participants had knowledge about the Participatory Budget, but a stakeholder changed their opinion. While in the Pre-Test stated:

> Yes, I think it's very important, and a way for poor communities to plan their needs (Extracted from the Focal Group, Porto Alegre, 2015).

In the Post-Test, the same respondent pointed out that:

> Yes, I think it was good but nowadays it has not so effective (Extracted from the Focal Group, Porto Alegre, 2015).

This change in their opinion took place within four months and was not expected.

Such results shows how "building capacities" and empowerment processes can be complex, demanding long-term actions, since cultural factors are difficult to identify and measure, interfering directly in the process and, consequently, in the results (Brandli et al. 2015; O'Brien et al. 2013; O'Rafferty; Curtis and O'Connor 2014).

In the Santa Maria group, four respondents (44.44%) reported having knowledge about the Participatory Budget. Among these, there is the participant who in the initial phase of the research (Pre-Test) stated that there was no such tool for participation in the city. This result shows that the methodology used has had an effect for this stakeholder, which could transform the concept learned into practical action.

Among the new members, one described the tool this way:

> Yes. It is where we debate what the priority of the neighbourhood or municipality is (Extracted from the Focal Group, Santa Maria, 2015).

Regarding the Participatory Budget, of the eighteen respondents, thirteen (72.22%) had a positive response, a percentage higher than that obtained in the Pre-Test (70.37%). Therefore for this item, the research may have interfered positively, since one of the Santa Maria stakeholders acquired knowledge about the process during the research.

3.3.3 Perception of the State Popular Consultation After the Capacitation

Regarding the State Popular Consultation, it is important to emphasize that during the development of the research there was no voting. Therefore, in this participatory instrument it was expected that there would be no change in behaviour, but rather in the justifications of the respondents.

In the Passo Fundo group, only the new member had never voted. Among the other members (75%), one of the participants pointed out that:

> Yes. But it was a long time ago. I think I was negligent about that (Extracted from the Focal Group, Passo Fundo, 2015).

This statement demonstrates that the stakeholder recognizes the importance of citizen participation in municipal management channels.

In the Porto Alegre focus group, three respondents (60%) had already participated. In comparison between the two questionnaires there was no change in the opinion of the participants, including a stakeholder, who in the Pre-Test said:

> I did not get a chance (Extracted from the Focal Group, Porto Alegre, 2015).

In the Post-Test she pointed out that:

> I do not know how to participate (Extracted from the Focal Group, Porto Alegre, 2015).

This response was also not expected, because during the research, among the various terms presented, it was explained what would be the Popular Consultation, which forms of voting, including emphasizing the possibility of participating online. This may be related to the fact that each individual has its intrinsic characteristics and, even within a working group, the paradigms of each participant act as a filter that influences the interpretation of information, making it difficult to transform (O'Brien et al. 2013).

In the Santa Maria group, none of the participants already had voted in the Popular Consultation, lower than the initial percentage (30.77%). However, there was a change of perception: one of the members who initially stated that there was no such process of management in the city, in the Post-Test justified his behaviour for not knowing. As previously emphasized, behavioural changes are long-term, this would be the initial step, accepting that the tool exists and therefore can be used.

Summarising, of the eighteen participants, only six (33.33%) had already voted in the State Popular Consultation, the majority for lack of knowledge of the

existence of this channel of shared management. This percentage was also lower than the one observed at the beginning of the research (40.74%). This data demonstrates the need for greater dissemination of participatory channels and the importance of promoting empowerment projects, conveying the reflection that the future of the city is dependent on the decisions made by the residents in the present. For, one of the objectives of participation is to create the political culture and practice of citizenship.

We emphasized that most important practical result of empowerment was observed in the Santa Maria group, where the members themselves organized and carried out a joint effort to collect solid waste in the neighbourhood. According to one of the participants the building capacity process was important for encouraging the group to take action. Thus, the aim of the research was to make each individual aware that he or she can make the place where a better place resides. Therefore, the methodology used has obtained partial results and can be replicated and improved in future studies.

4 Conclusion

As the main objective of this research was to empower citizens through education for sustainability, making them more active in their communities, we conclude that the goal was partially achieved, as some stakeholders changed their perception, being that the focus group of Santa Maria which developed practical actions after the insertion of the group in the project.

Despite the results obtained, one of the greater barrier faced in this research was to mobilize citizens to participate in the meetings and remain in the focus group on a constant basis, so it is suggested that in new research related to the theme, entities be involved so that they become sensitized to motivate their members to participate, because in the focal group of Santa Maria the Association of Residents and in the focal group of Porto Alegre the NGO Solidarity volunteered to contact their members, inviting them to participate in each one of research steps. Therefore, in these two groups there were a greater number of participants when compared to the focus group of Passo Fundo.

However, not only the number of participants, but also the motivation of each member was important for the capacitation. Thus, we suggest that the activities carried out during sustainability education projects should be improved during the application of the process according to the intrinsic characteristics of the focus group, since this experience showed that in the groups with higher education (tertiary education), the theoretical training was more effective. While for less degree educated and more proactive groups (for example, NGOs and Neighborhood Residents' Associations) it is suggested that interaction, in addition to theoretical expositions, should contemplate group dynamics and, at least, one punctual practice, so that the participants maintain interest in remaining in the research, since this will tend to become a more attractive and thought-provoking action.

Finally, the research showed that the University's interaction with the community should be promoted and intensified, as reflective and active citizens tend to adopt sustainable practices at the level of residence, expanding their actions to the work environment and in their communities, favoring the development of their citizenship and empowerment, achieving local sustainable development promotion.

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Right to the City and Public Policies: Current Perspectives of the Judicialization of Environmental Sanitation Policies in Brazil

Lorena Sales Araújo and Patrícia Borba Vilar Guimarães

Abstract The paper aims to make a reflection about the need of recognizing the right to the city as a fundamental right associated with the constitutional principles of the dignity of the human being, the social function of the city and the protection of the environment. In this context, the article will pinpoint the challenges of the contemporary city, emphasizing its urbanization process thought through a capitalist view and the necessity to guarantee the right to the city to all citizens, in special, through the fulfillment of the right to an environmental sanitation, having as parameters to this implementation the principle of sustainability and the concept of smart cities in order to equalize the need of economic development and the protection of the environment. Moreover, the paper will explore, briefly, how the brazilian superior courts have positioned themselves upon the recognition of the right to the city as a fundamental right and analyze a leading case from brazilian jurisdiction regarding the compulsory implementation of public politics to improve the quality of the water supply and sanitary sewage system, pointing out how the brazilian legislation treats the basic environmental sanitation system due to the educational environmental constitutional principle.

Keywords Right to the city · Sustainability · Smart city · Public policies Environmental sanitation

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1 Introduction

Brazil's Constitution establishes, when dealing with Urban Policy, in its article 182, as one of its objectives: 'to order the full functioning of the social functions of the city and to guarantee the wellbeing of its inhabitants' (DOU 1988).

With the constitutionalisation of the 'principle of the social function of the city', arises the discussion about the concretization of the *right to the city*, in its distributive perspective, understood as the right to live with dignity within the urban space, making possible to the population to have universal access to the essential services that a city must provide, as well as its participative dimension, which aims to ensure a more democratic management of cities, with the active and conscious participation of all its residents.

In fact, the problem regarding the recognition of the right to city as a fundamental right is a product from a repressed demand by under developed societies concerning the democratic right of participation and collective use of urban spaces, which will be analyzed, in this paper, by the judicialization of public policies to implement this right in both its dimensions, especially focusing on the *environmental sanitation* legal institute.

In addition, this paper will emphasize the importance of aligning the implementation of the right to the city with the remodeling of cities through a smart city concept and with the principle of sustainability.

2 The Right to the City as a Fundamental Right in Brazil

As a result of the progressive urbanization phenomenon, consisting in the growth and development of contemporary cities due to the increase of the population immigration from the country areas to the urban areas, the city has taken the spotlight in the discussions about the need to equalize quality of human life, environmental protection and economic development.

In this context, emerges the issue about the organization of the city public spaces. In fact, the city spaces should have been ordered in a way to emphasize its social function, its value of use and capability of bringing well-being for its residents. It occurs, however, that, according to Rolnik (1995), the cities have been built through a capitalist view, in which the urban space came to be understood as a product, leading to a subversion of the logic of organization and ordering of the city, which is now seen with the eyes of private property.

As exposed by Alves (2009, pp. 3–5), since the seventeenth century, worldwide, urbanism (the study, regulation and planning of cities) has been understood within this capitalist logic and Brazil urbanization process did not take place in a different way, valuing private property in detriment of social welfare.

Nevertheless, it is important to point out that there were several aggravating factors in Brazil's urbanization process, such as the accelerated pace of

urbanization, as well as the lack of adequate laws and institutions that could balance the situation, since, initially, the state action aimed only to the embellishment of the city, attempting to reproduce the European pattern of cities (Alves 2009, pp. 3–5).

To sum up, the increasing and rapid migration of the population from the countryside to the city coupled with the lack of state regulation aimed at an equitable and orderly distribution of urban land as well as the capitalist market influence, led to a very evident socio-spatial segregation in the country, making clear the separation between the formal and the informal city, still visible nowadays.

This urbanization process in Brazil propitiated a movement of segregation in which the richest live in places with adequate infrastructure, environmental sanitation and public equipment whilst the poorest are shoved to the periphery of the city, giving rise to informal occupations.

It is easy to see that the urbanization process was not and still is not a neutral process, since the organization of its spaces reflects the interests of the ruling classes and the pressures imposed by the social groups that fight for the recognition of their rights, making clear the relations of power that exists within the city, characterizing the city as the stage of a class struggle, where formal urbanization is opposed to the informal occupation of spaces (Feitosa and Hilário 2016, pp. 228).

In truth, as the low-income population do not have the means to acquire formal property, supplied with the minimal urban infrastructure to guarantee the dignity of the human being, once the commercialization of urban spaces increases the prices of the better structured areas, they end up generating an irregular occupation of spaces, through the invasion of vacant lands where there is still no adequate infrastructure for environmental sanitation, transportation, energy, among many other essential services.

It is easy to see, therefore, that cities, even today, despite the legislative achievements, further exploited in this paper, have, as exposed by Alfonsin (2008, pp. 22–35), a spatial hierarchy based on private property, that leads to a socio-territorial exclusion of the poorest population that does not have resources to afford the high prices imposed by the market in order to have access to the spaces with adequate infrastructure.

It is in this context of segregation, exclusion and hierarchization in the city that social movements arise claiming rights essentials to the dignity of urban life, gaining special color the concept of right to the city by Lefebvre (2000):

> The right to the city manifests itself as a superior form of rights: right to freedom, to individualization in socialization, to habitat and to inhabit. The right to the *oeuvre*, to participation and *appropriation* (clearly distinct from the right to property), are implied in the right to the city (pp. 173–174).

The concept developed by Lefebvre (2000), therefore, has two essential dimensions: the participative and the distributive. In the participative perspective, the right to the city translates into the guarantee of effective participation of the population in the production of urban space, through democratic and participatory management in the decision-making process on urban policies and reforms. In other hand, in its distributive dimension, the right to the city concerns the access and fair

distribution of urban goods and services, that is, the right of access by all residents to the essential goods and services that a city must provide.

Thus, the right to the city does not represent itself as a single right, but as a gathering of several social rights, fundamental to guarantee the dignity of the human being in the cities, linking both the right of participation in the public management of urban centers and the right of access to public facilities and services essential to life in the city.

In this sense, as Harvey (2012) explains, the right to the city is not limited to the protection of the right of a single individual to the participation and access to the city, but goes beyond, protecting the right of all the community that lives, interacts and modifies the city, therefore, characterizing a diffuse right.

At this point, it should be emphasized that Lefbvre's approach is in the sense of breaking the existing capitalist order, proposing an abrupt and radical reformulation of the social theory of organization thought through production. However, what is proposed in this paper, is to, through the contributions of the aforementioned author, situate such a right within the capitalist society that we live today, recognizing it as a fundamental right of the human being, as well as discuss the question of its implementation.

According to Júnior (2005, pp. 3–5), in Brazil, the search for the recognition of the right to the city began with the National Movement for Urban Reform (NMUR), whose objectives were the recognition of the right to the city as a fundamental right, the effective application of the principles of the social function of property and the social function of the city, as well as the implementation of democratic city management.

The work of the National Movement for Urban Reform (NMUR) led to the inclusion of a specific chapter of Urban Policy in Brazil Constitution (DOU 1988), which delegated to municipalities the planning and execution of such policy, expressly referring to the principle of the social function of property and the social function of the city, as well as instruments for its implementation.

Since then, according to (Cafrune 2016, pp. 188), NMUR has intensified its activities both nationally and internationally, and has participated in numerous events and congress, including the Global Forums on urban issues, which culminated in 2005 with the signature of the World Charter for the Right to the City.

This Charter was characterized as a valuable document at national and international levels, since it conceptualized the right to the city as the 'equitable usufruct of cities within the principles of sustainability, democracy, equity and social justice' (World Social Forum 2005, p. 2), relating the human rights already recognized in other international treaties to the urban question. With that, the right to the city became directly related to the fundamental right to the balanced environment and to the social function of property, rights protected by Brazil Constitution (DOU 1988).

Furthermore, with the promulgation of the Statute of the City (DOU 2001), which regulated the rights listed in the Urban Policy chapter in Brazil Constitution (DOU 1988), the right to the city was acknowledged, albeit not expressly, in both its participative and distributive dimension, aligning them with the principle of sustainability.

In effect, the Statute of the City (DOU 2001), established the general guidelines for urban policy, providing the guarantee of the right to sustainable cities. In this sense, the Statute went beyond the distributive perspective of the right to the city thought by Lefebvre, once it was not only concerned with the fair and equal distribution of urban resources, but with the quality of life of the population that lives there, as well as of the generations to come.

Thus, despite the fact that the right to the city is not yet fully consolidated, whether in our legal system or in international treaties and conventions, it does, by its content, configure itself as a fundamental human right, inherent in one's own dignity, since it is essentially linked to a set of rights of participation and access to goods and services essential to a dignified, free and now sustainable life.

2.1 Smart Cities and the Right to the City

In this scenario in which the concepts of sustainability and guarantee of the right to the city begin to gain prominence, the search for the reformulation of the cities through the use of new Information and Communication Technologies (ICTs), appears, generating the concept of Smart Cities.

In spite of the fact that there is still no univocal concept of an Smart City, it's common sense that the concept has as a prerequisite the innovation in the process of planning and management of cities, raising people's quality of life, guaranteeing environmental, economic and social sustainability, without, however, failing to provide an economic development.

In this sense, the concept promoted by Guimarães and Xavier (2016):

> An Smart city (…) is today widely studied as a contemporary phenomenon of urbanism, a way of life characterized by the wide citizen insertion of the individuals in the space of the city where they live and carry out their daily activities, with satisfactory attendance of their demands to move, work, communicate and relate to the environment, with the highest efficiency and quality of life possible. (p. 3)

The big question that surrounds the Smart Cities, therefore, is to build an environment conducive to the emergence of innovation and creative solutions to overcome the existing problems due to the adoption of the previously used model of urbanization, thought through the exchange value of spaces and not its value of use.

The creation of such an environment is only possible through the use and democratization of new information and communication technologies that allow the production and distribution, in real time, of information about the various aspects of the city, supporting decision making both by the city managers as well as by the citizens themselves, who can participate in a more conscious and active way.

Smart Cities, with their creative and innovative potential, are also shown as a way to achieve the right to the city, that is, to guarantee the universalization of city services, as well as the effective participation of all the residents in the management and ordering of spaces, turning out as a more realistic and effective solution to the

city organization and management problems than Lefebvre's proposal of radical break with the capitalist market model.

In Brazil, it is possible to notice some examples of the application of the concept of smart cities, highlighting the models adopted in the cities of Rio de Janeiro, Porto Alegre, Curitiba and Natal.

According to Weiss et al. (2014, pp. 7–10), in Rio de Janeiro stands out the creation of the Operations Center of Rio that monitors the city twenty four hours a day, processing a system of crisis management ready to deal with events such as heavy rains, landslides, problems in vehicular traffic, cuts in public services, among others. In addition, the operations center provides information on the conditions of the city status, especially on social networks, open to all citizens.

In Porto Alegre, there is a system of intelligent traffic lights that accelerate the circulation time by up to 30% and reduce the emission rate of pollutant gases by up to 7%. In Curitiba, the use of technologies to promote the transparency and efficiency of public management and democratization of information is highlighted, and public security and strategic information monitoring centers have been created (Weiss et al. 2014, pp. 7–10).

In addition, it is important to highlight the initiative of the City of Natal to join, through the Municipal Planning Department and the Municipal Council of Science and Technology, in partnership with the Instituto Metrópole Digital (IMD) from the Federal University of Rio Grande do Norte (UFRN), to the Brazilian Network of Intelligent and Humanities Cities, formally discussing solutions, through the use of new technologies, to the challenges that the city presents, an opportunity in which it starts its remodeling of the city through the launch of the Open Data and Tourism Intelligence programs.

In this context, it is possible to perceive that the use of the smart city concept by the cities mentioned above strengthens the concretization of the right to the city, both in its participative dimension, since it favors and encourages citizen participation in urban life from the democratization of information, as in its distributive dimension, since it allows the Government to do a more equitable distribution, in the material sense of the term, of essential services, according to the real needs of each place.

Considering the scope of the theme, this work will aim to analyze the search for recognition of the right to the city, having as a parameter the principles of sustainability and the concept of smart cities, regarding the environmental sanitation of cities, one of the most basic services and essential to urban life, but one of the most neglected.

3 Environmental Sanitation as Part of the Right to the City

In an extended concept of environmental sanitation, it is possible to say that this institute includes all activities that aim to guarantee a healthy and quality environment, however, some are considered more essential and therefore embrace a

more restricted concept called basic sanitation, which are: water supply, sanitary sewage, urban cleaning, solid waste management and rainwater drainage (Ribeiro and Rooke 2010).

The services and infrastructures needed to guarantee the basic sanitation are directly linked to the dignity of the human being and the right to the city, since they represent a minimum structure to guarantee both the health of the population, the development of the city and the protection of the environment.

At this point, when analyzing basic sanitation under the distributive perspective of the right to the city, that is, the right to access a fair and equitable distribution of urban services, we can perceive the great inequality that exists in the intra-urban space.

It is important to bear in mind, however, that, while this discrimination in the implementation of basic sanitation infrastructure and services more drastically affects the poorest sections of the population living in less valued areas, the whole city is disadvantaged, since basic sanitation services constitute an integrated system where the problems of one part of the town can easily spread to the rest of the urban space.

According to Dias (2009), to solve the large deficit in the basic sanitation system in Brazil it is necessary to implement an adequate urban planning, an effective urban and environmental legislation and agile, efficient and integrated action of environmental agencies and public managers.

In the perspective of the legislation, the major regulatory framework that establishes the general guidelines regarding the subject is the National Basic Sanitation Plan (DOU 2007), which, in its article 3rd brings the objectives of the basic sanitation policy, stating that the sanitation will be constituted by the services, infrastructures and operational facilities of potable water supply, sanitary sewage, urban cleaning and solid waste management, rainwater drainage.

According to Moretti and Moretti (2004), there is a great disparity between the deficit indexes in the availability of infrastructure and services concerning basic sanitation, the study points out to a clear prioritization of the service of drinking water supply, whose deficit is in the range of 6.4%, while sewage treatment has a deficit of 28.7% and the drainage, most scanty service, does not even have data.

In another context, it is important to note that the National Plan for Basic Sanitation (DOU 2007) contemplated the distributive and participative dimensions of the right to the city, in addition to aligning itself with the principles of sustainability and predicting the use of technological mechanisms, which opens space for the remodeling of the city according to the concept of smart cities.

In fact, in order to implement the distributive dimension of the right to the city, the Plan established among its guiding principles: universalization, integrality, availability, efficiency and economic sustainability, as well as the use of technologies appropriate to the provision of services.

In addition, in order to guarantee the participative dimension of the right to the city, National Basic Sanitation Plan (DOU 2007), includes as guiding principles: social control, understood as a ‘set of mechanisms and procedures that guarantee to society information, technical representations and participation in the processes of

public policies formulation, planning and evaluation related to public basic sanitation services', and the principle of transparency of actions, based on information systems.

In this context, the legislation, in several other articles, incites the use of the new information and communication technologies in order to make basic sanitation services smarter, allowing everyone a greater knowledge about the system and its deficiencies, providing a environment for creativity and sustainable solutions to the problems faced by these services, such as the publicity of reports, studies and decisions regarding the regulation and supervision of basic sanitation services in social medias, as well as the holding of public hearings and social control through consultative bodies composed by the government regulators, the service providers, the users and the technical and consumer protection entities (article 19, § 5, article 26§1 and 2, articles 27 and 29,§1º and article 47).

This is an incentive to remodel sanitation services from a smart city concept and it is a fundamental step towards the real concretization of the right to the city in both its dimensions, since the use of new technologies is essential to enable a greater and more conscious participation of the population, as well as the improvement of the quality and equal distribution of the services, since it allows a more efficient monitoring of the services, aligning them with the principle of sustainability.

It is therefore seen that the law under discussion brings all the necessary instruments to the concretization of the right to the city, in both its dimensions, including providing an opening for the introduction of new information and communication technologies in order to make the city smarter.

However, despite all the normative structure, constitutional and legal, and the solutions that can be achieved through the use of new information and communication technologies, implementing a concept of smart city, fact is, that there is a government choice in the implementation of basic sanitation services infrastructure, resulting both in the absolute lack of these services for part of the population and in the expiration of the already implemented system, which results in waste and inefficiency, damaging the environment and the quality of the population's life.

4 The Judicialization of Public Policies and the Right to the City

According to Andrade (2016, pp. 142–144) public policies are actions coming from the Public Administration tending to realize a right, thus, contrary to laws that are abstract and general, public policies are concrete and specific, seeking to materialize the law, in order to transfer the right from the paper to the real life.

It occurs, however, given the economic and physical limitations, that these instruments of realization of the right to the city, necessarily pass through a filter of political decision, that is, the public manager decides the priorities, pointing out which rights should be fulfilled first and where.

The electiveness given to the Public Administrator in relation to the prioritization of public investments coupled with the lack of effective and informed participation of the citizen in decision making, allows the emergence of arbitrariness regarding political choices, moving away the decisions from the primary public interest that aims at the good of the community and increasingly approaches secondary interest: the economic.

The implementation of the right to the city is also hampered by this electiveness, since the choices of the Public Administrator are often influenced by the capitalist vision of the market, generating what Santos (2013, p. 105) calls corporate urbanization, that is, within the organization, planning and structuring of urban spaces, priority is given to economic interests (exchange value) in detriment of the social and usability value of spaces.

In this scenario, the importance of the Judiciary arises in recognizing the right to the city as a fundamental right, necessary to guarantee a dignified life within urban spaces, to impel the Public Administration to concretize this right, both in its participative and distributive dimension.

4.1 The Most Significative Decisions in Brazilian Superior Courts

In a survey carried out on the websites of the Federal Supreme Court and Superior Court of Justice for the expressions "right to the city", "social function of the city", "statute of the city" and "democratic management", some decisions of relevance were found involving the topic in discussion in this paper, although in a timid and subsidiary way.

In the Superior Court of Justice, a decision proffered in the Action REsp nº 1.221.243 (Brasil 2014) it was determined the impossibility of recognizing the acquisitive prescription in cases of financing promoted by a public bank for low-income housing. In this decision it was emphasized the importance of the social function of property in urban spaces and it was recognized that the institute of urban acquisitive prescription created by the Statute of the City (DOU 2001) is only legitimate when it conforms to the requirements of city ordinance and has as purpose the satisfaction of citizens' needs.

Perhaps the most emblematic of the selected decisions in this paper, was uttered in the Action REsp nº 1.135.807/RS (Brasil 2012) that analyzed the possibility of using the space where it was located for many years a public park for the construction of a public office, recognizing the right to a sustainable city and, with that, the importance of green areas, parks, gardens and public boulevards for a dignified life within urban areas.

In another important decision given in the Action REsp nº 302.906/SP (Brasil 2010) the Minister Herman Benjamim, from the Superior Court of Justice, recognized the limitations of the Judiciary to manage cities, but emphasized its great

importance to promote the concretization of the right to the city, making feasible a sustainable city.

In the Supreme Federal Court, in the Action ADI 244-9 RJ (Brasil 2002), when analyzing the (in) constitutionality of the law that subordinated the appointment of the Chief Police of Rio de Janeiro to the "residential unit vote," the Court acknowledged that the aforementioned election reduced the electoral body to the taxpayers, that is, the owners and tenants of formal and regular property, subtracting from the choice the part of the city that suffers most from urban police violence. With this judgment, the Court, in spite of not being expressly stated, recognized the participative dimension of the right to the city, since it declared the unconstitutionality of a law that excluded the poorer sections of the chief policers' choice, a prominent position to guarantee security in urban spaces.

Another interesting decision uttered by the Supreme Court of Brazil is the Action RE 387.047-5 (Brasil 2008) that discussed the legitimacy of the institute of "parcel of land created", established by the city of Florianópolis. In this decision the court recognized that said pecuniary tax was an instrument of development policy, correcting the distortions that urban growth entails, aiming to promote the full development of the social functions of the city and property.

From the analysis of all the aforementioned decisions, it is verified that the national jurisprudence in the higher courts is still very timid regarding the recognition of the right to the city as a Fundamental Right, essential to the concretization of the dignity of the human being within urban spaces. However, we cannot fail to celebrate the achievements already made towards the recognition of the right to the city and the importance of the judiciary in boosting its implementation.

4.2 Case Study: The Judicialization of Environmental Sanitation in Natal City

In a survey carried out through the PJE and E-Saj, systems that contain electronic judiciary decisions from local courts, looking for public civil actions involving environmental sanitation, it was possible to perceive the lack of actions regarding the topic in the city of Natal, since there were found only two actions directly related to the theme.

In fact, we have the Action Ação civil Pública 0114944-97.2011.8.20.000 (Brasil 2016b) that aims to solve problems related to the drainage system in the neighborhood of Alecrim in Natal, and was judged based on the right to the balanced environment and the constitutional guarantees of life, health and dignity of the human being, recognizing that basic sanitation services constitute social rights, essentials for the development and promotion of the well-being of the inhabitants of the city.

In the other Action Ação Civil Pública 0200202-17.2007.8.20.0001 (Brasil, 2016a) found, the main goal was to guarantee an effective water supply system in

the City of Natal, and partially upholded the authors pleas to determine to the public concessionaire of services defendant to: (1) decontaminate the water supplied to the population of the municipality of Natal; (2) reformulate the water monitoring system, in order to verify its quality adequately, making the data available online, giving it publicity; (3) acquire the environmental licenses and (3) implement a sanitary sewage system in order to serve the entire population of Natal, avoiding new water contamination.

From the analysis of the decision above, it is verified that it was guaranteed the right to environmental sanitation, more specifically the right to have a water supply and sanitary sewage, based only on the right to a balanced environment, health and dignity of the human being.

Although, it was not mentioned expressly the guarantee of the right to the city, when the decision determined to the public concessionaire of services to ensure for the entire population of Natal an efficient sanitary sewage system, as well as the decontamination of the water supplied to the city, it was a step to the concretization of its distributive dimension, since it ensured that all inhabitants of the city benefit from basic and essential sanitation services.

In addition, although in a timid manner, the decision, following the guidelines of the legislation, determined that the reports on the water quality of the municipality of Natal remained available in the web, thus promoting a greater distribution and popularization of the information about the sanitation service provided by the public concessionaire of services, also giving the citizen the possibility of informed and conscious participation in the public decisions concerning these services. This way, the decision ended up concretizing the right to the city in its participative dimension, using the basic tools of the smart city concept, that is, through the use of new information and communication technologies.

Returning to the analysis of both aforementioned judgments, we can perceive that the jurisprudence is still scarce regarding the recognition of the right to the city, both in its distributive and participative dimension, however, the rights that encompass it have been recognized through an illation with other fundamental rights, such as the right to a balanced environment and the dignity of the human being.

In addition to this deficiency regarding the recognition of the right to the city as a fundamental right, it can be seen that the judiciary did not even consider the importance of using the new information and communication technologies as an effective and viable way of promoting the concretization of the rights encompassed by the right to city, alternative already provided for in the legislation to basic sanitation that brings as principles to guide de implementation of these basic services the social control and the transparency based on inclusive information systems.

In this context, it is important to emphasize that it is understood that the judiciary cannot interfere in the electiveness of the Administrator to freely choose the most appropriate technologies to be used for the concretization of the right, but existing in the law, as already highlighted in this paper, the Administration's duty to use these technologies in order to allow social control and an efficient service, it is the

responsibility of the judiciary to encourage this remodeling and update of the cities, through a smart city concept, indicating in its decisions the need of the public manager to align to this new concept.

5 Final Considerations

The present paper emphasized the importance of the judiciary as a impeller of the implementation of public policies in the sense of concretizing the right to the city in both its dimensions, through the judicialization of public policies involving basic environmental sanitation.

From the analysis of the decisions of the courts selected above, it is concluded that the higher courts do not fully recognize the right to the city as a fundamental right of compulsory concretization, but recognize only some of the rights that englobes the aforementioned right to the city, thus impelling its concreteness in a punctual and fragmented way, without the vision of the whole.

Furthermore, as regards basic environmental sanitation, it should be noted that, in spite of the fact that it is essential for a decent life in urban areas, protection of the environment and economic development of cities, and the existence of comprehensive and advanced legislation on the theme that brings instruments aligned both with the principle of sustainability and with the concept of smart city, through the use of new information and communication technologies, fact is that this service is still neglected by public managers, especially in the places inhabited by the city poorest population.

Thus, this work calls attention to the need to judicialize public policies, institute directly linked to the concept of judicial activism, described by Barroso (2009) as 'the ample and intense participation of the Judiciary in the concretization of constitutional values and goals by an intense interference in the acting area of the two other Powers ' (p. 6).

Furthermore, this work points out the need to judicialize public policies with the objective of concretizing the right to the city by guaranteeing basic sanitation to all who live in the cities and not only in the most privileged neighborhoods, always aligning the concretization of this right to the principle of sustainability and social function of the city, the right to a balanced environment and taking into account a smart city concept, in order to use the new information and communication technologies to implement said public policies in an efficient and sustainable way, with the active and conscious participation of all residents of the city, as already expressly provided by law.

The purpose of this work, therefore, is to encourage civil society and the Public Prosecutor's Office to continue the quest for the concretization of the right to the city, especially in relation to basic sanitation, as well as to urge the Judiciary, despite its limitations considering the principle of the separation of powers, to recognize the right to the city, in both its dimensions, aligning it with the principles of sustainability and the social function of the city and to alert the managers about

the possibility of the use of the new information and communication technologies, once already provided for the law, indicating as a better way to achieve the effective concretization of the right to the city through a smart city concept.

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Remote but Connected: Ownership-Inspired Behavior-Driven Development and What an E-Learning Governance System for Africa Could Look like

Judith Gottschalk and Nicolai Winther-Nielsen

Abstract Using e-learning technology is one key for developing sustainable education in urban and remote areas in Western Africa as it reduced the demands on students who are well integrated in their rural society to leave their homes for an expensive education. In this chapter we present Ownership-inspired Behavior-Driven Development (OIBBD), a development strategy designed for e-learning governance in remote areas in Africa to support sustainable education as part of the agenda 2030 and the Sustainable Development Goals (SDGs) and show how the design of a User Experience (UX), which is based on user-centered design and feedback from the African target group can be used to support the implementation of e-learning in Africa. We reflect on how a governance for sustainable development in theological education on the African continent can look like. We ask how such an e-learning governance can support remote e-learning in hard to reach areas in Africa and how this can be designed specifically of the needs of the African socio-culture. The guiding hypothesis of this chapter is, that especially leadership and its activation in African teachers can trigger them to develop ownership in using e-learning technology and this way supports the reaching of SDG 4, which deals with sustainable education.

Keywords E-learning · Development cooperation · Sustainability Africa · E-learning governance · Hard-to-reach regions

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1 Introduction

Many African countries lack a well-established educational system, and a high percentage of African adults are illiterate. Where schools do exist, they are situated close to larger cities, such as Freetown in Sierra Leone or Kinshasa in the Democratic Republic of Congo. Given this background, the present chapter addresses the following problems:

(a) What does sustainable e-learning technology for Africa look like in terms of connecting remote theological seminaries to the Internet, despite being in hard to reach areas and daily blackouts?
(b) What does governance for remote e-learning in Africa look like when it is designed to address the challenges of African socio-culture?

Our hypothesis: The use of e-learning technologies is one key to the development of sustainable education in remote areas of Africa, since such technologies reduce the need for students in rural societies to leave their homes to pursue expensive education. Based on this hypothesis, we present the concept of ownership-inspired behavior-driven development (OIBDD), a development strategy designed to help e-learning governance support sustainable education in remote areas of Africa as part of the United Nations' Agenda 2030.

The Virtual Faculty developed by the British/Danish faith-based organization (FBO) Relay Trust is one e-learning tool that aims to support Christian formation on a grassroots level in hard-to-reach areas of Western Africa by providing education to future church leaders. The Virtual Faculty is an app for Android smartphones (which are common in Africa) that grew out of fieldwork in Nigeria, Sierra Leone and Madagascar. The app supports Christian formation on a grassroots-level.

The concept of OIBDD was developed during two fieldwork trips to Madagascar in October 2015 and April 2017. The system is based on the assumption that most e-learning systems require a constant internet connection and electricity and are designed for people who are computer literate. However, on the African continent, there are two huge challenges in establishing e-learning systems: (1) finding a sustainable solution that works and keeps track of students' learning progress in remote areas, regardless of internet connection, and (2) designing the software in such a way that its users are not overwhelmed by the act of using the e-learning technology. In the field of mobile ministry, providing people in remote areas with the means to use e-learning systems that solve their technical problems and are simple enough for use by people with minimal computer literacy poses a significant challenge.

The Virtual Faculty offers a means to develop inclusive and quality education to support the United Nations' Agenda 2030 and SDG 4, which the United Nations hopes to achieve within 15 years of 2016. SDG 4 deals with quality education and aims to "Ensure inclusive and equitable quality education and promote lifelong

learning opportunities for all".[1] The SDGs, which succeeded the Millennium Development Goals (MDGs), aim to motivate global efforts to address poverty, inequalities, and climate change. The chapter is organized as follows: In Sect. 2 we discuss the background on which the design of the Virtual Faculty developed by Relay Trust for the African continent looks like and introduce Ownership-inspired Behavior-driven development. Section 3 deals with the methodology used for the development of a sustainable e-learning governance for Africa and Sect. 4 presents an e-learning approach for Western Africa.

2 Background

The persuasive framework introduced by Winther-Nielsen (2014), which I have been using for my work in Madagascar and will use for work in Western Africa, emerged out of B. J. Fogg's (2003) work on computers as persuasive technology. Winther-Nielsen (2014) implemented this system within Bible Online Learner using the Learning Journey plug-in and Laurillard's (2012) model for learning practice capabilities from an external environment. Winther-Nielsen (2014) developed a persuasive model called RAMP, which he uses to explain how corpus-driven language learning can be incorporated into a persuasive model.

This chapter discusses the governance for the sustainable development of an e-learning system in a remote theological seminary. In the seminary, teaching using technology is challenging due to environmental constraints (e.g. electricity black-outs and unstable Internet connections) and user-related constraints (rooted in the reality that most e-learning systems are designed for the needs of Global North societies). An important concept for e-learning governance is Kairos, or the best moment at which to present a message (cf. Fogg 2003). Technology can be used to identify the ideal moment to motivate students and encourage them to make the most of their learning (cf. Winther-Nielsen 2014); however, e-learning projects developed in the Global North usually face challenges when they are implemented in Africa. Teaching methods like the flipped classroom (cf. Winther-Nielsen 2014) are designed to suit students in primarily individualistic societies (cf. Danner 2012). By contrast, African societies are based on elder systems, such that village elders have a say in all decisions. In such societies, the concept of the individual is not as present as it is in Europe. Instead, in Africa, people identify themselves through their communities, traditions, and relationships (cf. Danner 2012). An African student would not stand up in a flipped classroom and ask a tricky question because he might question the professor's authority and, hence, his role as an elder. From a governance perspective, therefore, African society is structured as a classical hierarchy, while in e-learning systems, students are treated as individual actors who can determine the pace of their own learning.

[1] https://sustainabledevelopment.un.org/sdg4.

The potential role of information and communications technology (ICT) in development projects has been acknowledged by UNESCO (2005). Many additional articles have explored ICT projects in Africa, including projects related to public infrastructure, governance, accountability, civil society, entrepreneurial and economic activity, and access to global markets and resources (Thomson and Walsham 2010). For example, Bada (2002) discussed the adaptation of a local bank's enterprise resource planning system, while Braa and Hedberg (2002) used ICT to empower health workers in South Africa. Ngwenyama et al. (2006) dealt with health education in West African countries and determined causality from statistical correlations between ICT investments in health and education. One critique of these studies, as presented by Thompson and Walsham (2010), is that they have focused not on strategic development, but on the design and implementation of solutions for specific developing countries. In this chapter, I aim to develop a governance strategy for e-learning in African countries that will provide future faith actors with in-depth theological knowledge, support teaching, and improve sensitivity to the SDGs.

In 2012, during the United Nations' Rio+20 summit, several governments committed to creating a set of SDGs to serve as the follow-up to the MDGs, which reached their deadline in 2015 (cf. Griggs et al. 2013). In this way, the development paradigm, including issues concerning the economy, society, and Earth's life-support system, was achieved (cf. Griggs et al. 2013). The MDGs were a historic achievement because they helped to mobilize countries worldwide to address social priorities. The SDGs go a step further, adding the concept of sustainability to all efforts to improve global development, including efforts related to education. We extend the information technology (IT)-sector concept of behavior-driven development (BDD) to develop a strategy that I call ownership-inspired BDD (OIBDD). BDD was introduced by North (2006) as an improvement to test-driven development, in which programmers first write a software test that fails and then make small changes until it works. BDD uses stories as a starting point. In our context, formulating a story means developing a causal chain to be completed through the development work project.

In the context of development cooperation, the concept of ownership is indispensable. Ownership means that local partners take over full responsibility for their development through collaborations with partners from the Global North. Ownership requires partners to assume responsibility for their own development and gives them the self-confidence to cooperate with overseas partners. Such self-confidence is not always certain in development work due to the common occurrence of dependence relationships. However, ownership creates partnerships, and partnerships between local partners and operating non-governmental organizations (NGOs) are required to achieve the SDGs (cf. Nuscheler 2012; Rauch 2012). In our project context, this implies a mutually beneficial relationship in which African partners are empowered to be independent and equal, rather than colonially ruled. By applying a sound user-centered design, we aim to empower staff and students at a university in the Global South to enable future church leaders to fill the ethical gap in the SDGs.

The goal of a persuasive technology in a development context is to achieve behavioral change and create intrinsic motivation to exhibit a specific behavior (cf. Fogg 2003; cf. Winther-Nielsen 2014). This requires the concept of ownership to be enabled within the context of developmental cooperation. As pointed out in Theisohn (2003) an important drive of creating a transformation to support ownership, is to use the concept of leadership, which can be caused by participation as pointed out by Rauch (2012). This mirrors what the Paris Declaration on Aid Effectiveness stated in 2005 (cf. UNESCO 2005). Thus, the main objectives of creating ownership and responsibility for partner organizations in a context like Africa are to provide these organizations with feedback and to monitor the actions they take to complete their developmental cooperation projects.

When developing a persuasion strategy, one must determine the message and how it will be transmitted. In other words, the following question must be answered: How will a user utilize the software to reach a specific state or change a specific habit (cf. Oinas-Kukkonen and Harjumaa 2009)? Concepts like Participatory Well-being, Situational Analysis and Goal Establishment, Performance Appraisal Groups, and Participatory Impact Analyses, all of which originally come from Participatory Rural Appraisal, can be used in this context. The goal of the app is to improve the educational governance of an African university, to help the university develop a curriculum rooted in the SDGs, and to use this persuasive concept as a strategy for the development of e-learning and IT governance in developing countries.

The concept of Kairos is essential to creating ownership, as my hypothesis is that ownership is a Kairos itself. The goal of persuasion is important. For example, people who would like to play more sports might enjoy jogging on a warm, sunny day; these people might achieve Kairos when a persuasive system suggests that they go jogging on such a day (cf. Øhrstrøm et al. 2009). A number of identifiers, such as keyboard or mouse activity or physical measures, such as heart rate or breathing rate (cf. Øhrstrøm et al. 2009), might help to estimate when specific instances of Kairos occur. Such factors typically have causal impacts on the presence of a Kairos, while the Kairos has a causal impact on the identifier (cf. Øhrstrøm et al. 2009).

One Kairos in my model is ownership. As Fig. 1 shows, the following factors influence ownership and create a Kairos: (a) leadership, (b) participation, (c) feedback, and (d) monitoring. Within my model, these four factors, which were derived from Theisohn (2003); Rauch (2012) and Nuscheler (2012), are random variables that constitute the Kairos of ownership. Figure 1 describes an ontology of the Kairos of ownership, which is defined by the above-mentioned four variables (cf. Øhrstrøm et al. 2009).

Each of the three aspects of the persuasive analysis uses the four variables (i.e. leadership, participation, feedback, and monitoring) from my ontology of ownership described in Fig. 1 as persuasive functions to create a Kairos of ownership within a development project. User-centered design is a strategy in which persuasive design and governance go hand-in-hand. In addition, it is possible to involve the partner organization in the process of developing an app to motivate the

Fig. 1 Network of ownership

organization to create ownership, which supports participation in developmental cooperation, the basis for community empowerment. Then, the second element of my governance approach, BDD, creates the case for e-learning governance: OIBDD. Through OIBDD, teachers are able to assume leadership and become part of the curriculum development process through their teaching in an e-learning context. This makes teachers responsible for their teaching and gives them the ability to participate in university processes. Through teaching ownership and responsibility, I gradually turn the hierarchical, elder-based model of an African university into a network structure.

3 Method

With respect to the development of educational governance for e-learning systems to reach sustainable development on the African continent, it is important to consider how users can interact with the e-learning systems in ways that supports their goals and their ability to take over ownership of the systems.

Robert and Lesage (2011a, b); Alben (1996), define the concept of user experience (UX) along the lines of the concept of ownership. The UX design elements are as follows:

- The user: Within an e-learning system, these are the staff of a remote seminary and the learners who use the e-learning system.
- The system: This is the e-learning system itself, with all its functions and qualities. The user interacts with this system.
- The activity: This is the action taken by the users of an e-learning system. In the case of using an e-learning system for theological education, activities could include reading or highlighting supported texts or listening to audio files.
- The context: In my specific case, this is sub-Saharan Africa, a developing country that faces several challenges (e.g. electricity blackouts and a lack of internet connections).

(cf. Robert and Lesage 2011a)

One of the key concepts of OIBDD is the application of user-centered design, which is characterized by its focus on users and its strategy of constantly collecting and incorporating user feedback throughout the application development process (cf. Robert and Lesage 2011a). User-centered design is based on empirical data.

We received these data from, among others, fieldwork conducted with the NGO Danmission during a project in Madagascar. Once the e-learning system for the Virtual Faculty is installed in Western Africa, we will use the constant user data received from Sierra Leone to improve the system. The design process for user-centered design is iterative (cf. Robert and Lesage 2011a, b), as the system needs to be adjusted to the specific needs of African users to produce an integrated design (cf. Robert and Lesage 2011b). Using this user-centered design approach, we are able to develop educational governance for an e-learning system that relies heavily on SDG 4 and to develop a sustainable approach to educating future church leaders in remote areas of Western Africa.

The e-learning system has two user groups: the staff (technical and teaching) and the students. Each of these user groups has specific needs. As pointed out in Sect. 2, an essential element of OIBDD is the Kairos of ownership as the driving force encouraging acceptance of an e-learning system. Within this e-learning model, the theological seminary staff is a driving factor, and teachers or advanced students are the ones who take over the teaching once the overseas partner organization has left.

The question is: How can the variables that constitute ownership in such an e-learning setup be triggered? One important factor is the ease of the use of the software, meaning that our e-learning technology makes as much use as possible of concepts known by people from the oral cultures of Western Africa. For example, the login process is based on either a Facebook login (due to Facebook's widespread use for communication on the African continent) or a picture-based login, which allows users to log in without an e-mail address or password. This latter option uses emojis rather than digits and letters, since these are easier for illiterate people from an oral culture to remember. If the login system had been set up in a way that was difficult to manage, the vast majority of African teachers would not use the system in their teaching. The reasons for this lie within the African socio-culture: African teachers are reluctant to use e-learning technology that is difficult for their students to use. From a sociological perspective, teachers who wish to use e-learning technology must take a risk and accept a situation of uncertainty, which they typically try to avoid. In particular, elders, who are higher in Africa's social structure, wish to avoid situations where they risk losing face. Because e-learning systems are unfamiliar, teachers can easily become de-motivated from using such systems and reject their use in the educational process.

It is important to understand the concept of leadership from an African perspective. African society—and, thus, African leadership—is based on relationships and the communities within which individuals act (cf. Kuada 2010). One way to support leadership in Africa is by triggering thought leadership, thought liberation, and critical consciousness (cf. Gumede 2017). This approach positions leadership as a trigger for ownership in African society based on the participation of leaders in an African e-learning system. One way to encourage this is through a UX design, in which the e-learning tool strengthens teachers' positions in the classroom without adding risk, thus helping the teachers develop leadership. This can be achieved through the persuasive means of an easy-to-use e-learning system and a shift away from heavily text-based computer systems.

When using a login process based on pictures instead of e-learning addresses, it might be best to use pictures other than pictures of the students. Many students in rural areas have never seen their own faces and do not know what they look like because they have no mirrors. By comparison, the students' animals, goats, and cows have great meaning to them and, in some African tribes, may even be used as a currency. In such societies, it might be reasonable to use pictures of the students' cows or goats, which they can clearly identify, for logging into an e-learning system. Such considerations may ease the students' use of these systems.

One strategy for removing the hurdles facing students with minimal computer literacy is using grassroots volunteers who give the students individual lessons in how to use a computer, the internet and e-learning technology. Grassroots volunteers are usually young people aged 18–27 with ordinary computer literacy. These people are not considered dangerous by the students because they are not part of the university's hierarchy, do not place the students in a difficult situation and make it possible for the students to feel mutual trust, all of which may ease the students' learning.

Another important aspect in the successful application of my e-learning governance is that of feedback and monitoring through the overseas partner organization. Laurillard (2012) has shown that feedback is a driving force in e-learning, and Fogg (2003) has similarly shown that feedback is a persuasive function that prompts system users to change their mode of use. In the context of the implementation of an e-learning system for Western Africa, we use feedback not only within the system itself, but also within the relationships between the local partners and the overseas partner organization.

In this system, we deliberately use Fogg's (2003) concept of feedback as one means of persuasion in the Virtual Faculty; however, we remove all competitive elements in the feedback function. From our perspective, such competition can lead to weaker students being left behind by their fellow students, particularly since, in hierarchical societies (e.g. African societies), stronger students do not support weaker students. For example, in the case of the theological university in Madagascar, we noticed that some students developed a great deal of knowledge, but were hesitant to share it with their fellow students. The reasons for such behavior were usually rooted in the cadre system of many African universities, in which students begin to compete even during their early years of study (e.g. when applying for studying abroad for master's degrees in Europe or the United States). This situation is particularly typical of Francophone countries, since Anglophone countries (e.g. Kenya) preferred to educate national elites during British colonialization (cf. Danner 2012).

In our Virtual Faculty and the accompanying e-learning governance, we work against the concept of removing students from their remote rural context. Instead, the development projects seek to improve the SDG-inspired education of pastors in remote areas, since church leaders are often the only people in a village who receive higher education. However, because of their high relative literacy levels, church leaders often earn most of their income through teaching in schools and lead their churches as a side job.

Development projects have tested several models of higher education for pastors. Especially in Francophone countries, students tend to be sent to France to receive higher education. However, these students must deal with intercultural challenges, such as keeping up with students who grew up within European educational systems and are not expected to meet the demands of their families and villages. As a consequence, many students do not finish their degrees—or, if they do, do not return to their home countries. Living abroad is often a challenge for African students, since many cannot afford tuition fees. For this reason, the students selected to study abroad are often not the best qualified, but the ones with the best connections. Nevertheless, some students receive degrees, even Ph.D's. However, many universities do not consider holders of African Ph.D's to be equally qualified as holders of European Ph.D's. The SDG-inspired curriculum can address this situation by using modern technology—and, particularly, mobile applications—to support educational opportunities in Francophone countries in Western Africa.

The final persuasive element we use in the design of Relay Trust's system as part of our e-learning governance is the concept of tunneling, as introduced by Fogg (2003). Tunneling is the concept of leading students through the e-learning system without forcing them to make too many decisions. Tunneling can support ease-of-use by preventing students with minimal IT literacy from getting lost within the system.

Finally, the use context of the e-learning system in Africa is crucial. Here, we must differentiate between the narrow use context (which has to do with a specific domain), the e-learning system, and the broad use context (which has to do with the use of the e-learning system in Africa). In this chapter, we focus on the broad use context. Within this context, the e-learning system must be able to address the following issues: (a) electrical problems, (b) problems with internet connections, and (c) problems with poorly trained staff. E-learning governance should focus particularly on this last issue, since issues with infrastructure and electricity can be compensated for by a well-trained and innovative staff.

With respect to staff training, several points are relevant. Management leadership (e.g. by the dean of a university) is important, and it is critical to consider how such leadership is implemented with respect to employees (i.e. are they encouraged to submit their own ideas, or are they permanently defensive?) (cf. Kuada 2010). The leadership style chosen by management affects employees' motivation. When a leader is able to base her leadership on the important pillars of African society—namely, relationships—and empower her staff, then the staff is likely to be more motivated. The final challenge is the sustainability of IT training for staff in African universities. Here, the point is: The better trained the staff is, the less likely they are to stay in their positions, unless they are paid well enough to live comfortably on their incomes and feel challenged enough by leadership to stay in their jobs.

4 An E-Learning Approach for Western Africa

The curriculum developed by Relay Trust follows a staircase model that aims to support Christian formation at all levels of church leadership. Within this program, practical and theoretical trainings are combined and supported by experiences from church life. Through these trainings, lessons are constantly adapted to meet practical implications and contextual realities to ensure that they are relevant to the students and the church. Relay Trust makes training available in local and remote contexts instead of bringing students into foreign contexts. Especially at higher educational levels, the program enables learners to gain deep theological knowledge to support their efforts to obtain bachelor's, master's, or doctorate degrees in theology. Using the staircase model, students can continue to further their training and advance to higher levels, provided they are motivated and have the necessary skills. The advantage of the staircase model is that students can follow their own learning progress. Every step in the system is a closed unit and prepares the student for a certain level of leadership. The staircase model is shown in Fig. 2.

Relay Trust defines itself as an FBO that aims to help struggling evangelical, mostly Anglican churches fight against organizational challenges stemming from poor pastor education. All the churches the Relay Trust partners with are situated in countries listed in the last third of the Human Development Index (e.g. Gambia is 172nd, Sierra Leone is 183rd, and the Democratic Republic of Congo is 186th).

The low rank of these countries in the Human Development Index means that they lack well-established educational systems with primary schools. The development projects seek to improve the education of pastors in remote and

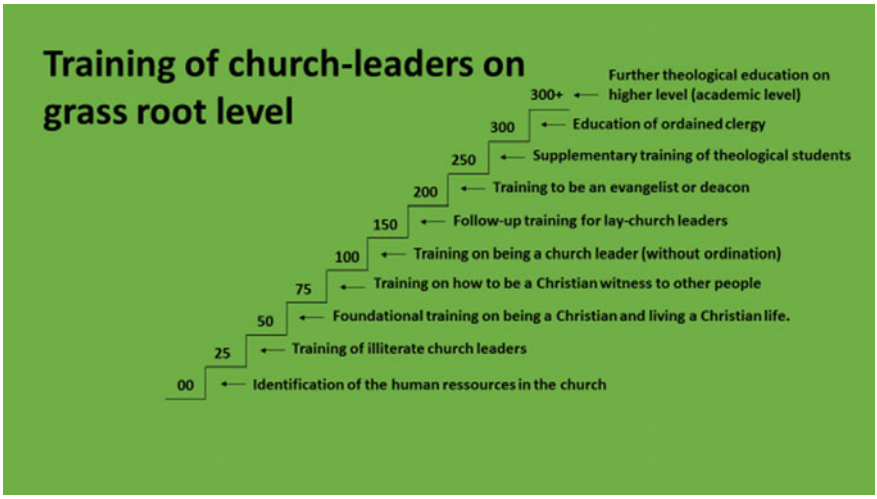

Fig. 2 Staircase curriculum developed by Relay Trust. We publish this figure with friendly permission from the Relay Trust

hard-to-reach areas, since educated church leaders are often the only people in a village to receive higher education. However, because they are literature, church leaders typically work primarily as teachers in schools and lead their churches as a side job. In such cases, they earn most of their income through teaching in schools.

The technology is based on the types of smartphones and tablets found throughout the African continent (Fig. 3).

Relay Trust's concept is simple: since many theology students in Sierra Leone and other African countries are situated in remote seminaries and since mobile phones are widely available on the African continent, the Trust developed a portable seminary based on the Virtual Faculty app presented in this chapter. Using this app, students can work at home or at a university to progress through the staircase training at a grassroots level. Thus, theological training can use technology to support SDG-based training.

In the conception of portable seminaries in remote areas, uses local WiFi connections. Such networks are independent from internet connections, which, especially in areas like Sierra Leone, the Democratic Republic of Kongo, or Gambia, are difficult to establish and maintain. For the WiFi connections, we use mini-computers, such as Raspberry Pis, which can run on solar power. Raspberry Pis also use so-called network attached storage (NAS), which can be used to store audio files and videos downloaded by students. Such storage is particularly important in Western Africa, where the students come from oral cultures and prefer oral learning over written communication.

An advantage of using solar power and new mini-computers instead of desktop PCs or stationary servers is that these options are more sustainable in terms of stability and power usage (compared to, for example, re-furbished computers, which are important in the Global North). Remote theological seminaries face challenges of ensuring a consistent power supply for laptop servers and computers

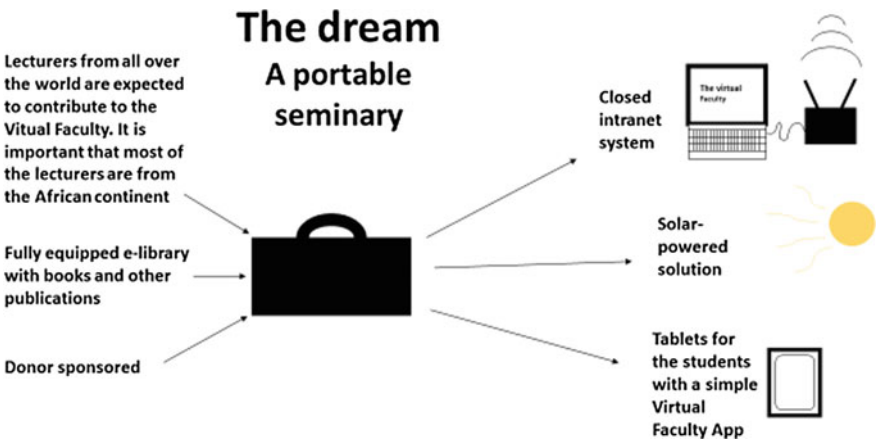

Fig. 3 Portable seminary for church leader training. We publish this figure with friendly permission from the Relay Trust

using solar power. In most cases, it is not possible to run these machines on solar power due a lack of sufficient power and the higher energy requirements of older and re-furbished computers in comparison to Raspberry Pis.

Another sustainability aspect of the portable seminary stemming from the use of alternative computational devices is that the seminary gives struggling churches the opportunity to learn project budgeting through concrete examples with support from the Relay Trust. With portable seminaries, it is also possible to train local staff in various competencies to support the seminaries and, thus, create jobs.

5 Conclusion

Based on a case study in Madagascar and on fieldwork experience in Sierra Leone and Nigeria, this chapter has shown what sustainable e-learning technology can look like for Africa by using e-learning apps that run on occasional internet connections and independent WiFi systems in rural seminaries using solar power. We have also described an e-learning governance system for helping remote e-learning areas in Africa meet the challenges of African socio-culture. Such a sustainable e-learning governance is based on the Kairos of ownership and is heavily influenced by the concept of leadership, which can be supported by a persuasive computer system that is easy to use, involves as few hurdles as possible and is designed to encourage the participation of students and teachers from oral cultures. This way, the present study supports the development of a sustainable e-learning system for Africa capable of supporting SDG 4, which calls for sustainable and equal education worldwide by 2030.

The limitations of this chapter are that we have derived the knowledge of the African society and of the technical limitations of e-learning in Africa and its governance first and foremost from research in Madagascar, which as an isolated island differs in the structure of its society from other African countries and is developed much farer with regards to internet connections and students possessing smartphones.

Nevertheless, we believe that this research can be used as a first starting point for exploring the potential of OIBDD for other regions in Africa, e.g. for Western Africa.

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Part IV
Social Determinants of Health Oriented to Sustainable Development Goals

How Can the Healthy Municipalities, Cities and Communities Strategy Advance the Sustainable Development Goals Agenda? Lessons from Agenda 21 and the MDGs in Brazil

Marcia Faria Westphal, Maria Cristina Franceschini and Andréia Faraoni Freitas Setti

Abstract Since the 1980s, the Healthy Municipalities, Cities and Communities Strategy (HMC) seek to advance health promotion processes and practices and to improve quality of life in the countries of the Americas. Its core pillars include developing healthy public policies and strengthening social participation and intersectoral collaboration, with a strong emphasis on good governance and sustainability in order to promote structural and systematic changes for the social production of health. Recently, the importance of investing in Healthy Municipalities, Cities and Communities has been emphasized as key for the achievement of the Sustainable Development Goals (SGD). Healthy Cities was also highlighted as a central theme in the 9th Global Conference on Health Promotion, organized by the World Health Organization (WHO 2017). Local level action, spearheaded under the HMC framework, that seek to promote health equity and integral public policies have the potential to link national and international agendas,

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such as the SDG, based on the real needs of the territory and its population. Brazilian municipalities have developed rich experiences with the implementation of Agenda 21 and the Millennium Development Goals (MDG) over the past few decades. These experiences can form the basis to reflect upon how to advance the SDG agenda by incorporating it into local agendas through a Healthy and Sustainable Municipalities, Cities and Communities Strategy. Networks of HMC, that are present throughout the American continent, can play a key role in this process for its capillarity and potential to mobilize actors at various levels of action. They can also be strategic to promote capacity building and education process to strengthen communities' ability to promote sustainable actions. This chapter will include a revision of the lessons learned from the experience of Brazilian municipalities with the implementation of Agenda 21 and the MDG as well as a reflection on the role of networks to promote the SDG agenda. It will finalize with recommendations on how to advance the SDG agenda in local agendas as part of the HMC strategy.

Keywords Sustainable development goals (SGD) · Healthy cities Agenda 21 · Millennium development goals (MDG) · Evaluation

1 The Healthy Municipalities, Cities and Communities Movement in Latin America

The Healthy Municipalities, Cities and Communities (HMC) movement has grown rapidly since its launching in the 1980s (Hancock 1993). What initiated in Europe as a "Healthy Cities" project of the World Health Organization (WHO), soon took hold in North America, and subsequently in Latin America. In contrast with more urbanized European context, in Latin America the movement incorporated the regional reality of urban and rural settings as well as its more fluid administrative and geopolitical arrangements, which included municipalities and communities and a very diverse cultural, geographic, linguistic and political context (Rice et al. 2017).

Although different definitions of Healthy Cities have emerged and evolved over time, at its core, Hancock and Duhls' concept express the movement's core tenets: a healthy city is one that "continually creates and improves the physical and social environment, as well as strengthens community resources which enable people to mutually support each other in performing all functions of life and achieving their maximum potential" (Hancock and Duhl 1986). Creating a Healthy City requires the strong leadership of local governments, the development of healthy public policies, active community participation, the creation of supportive environments, and the reorientation of health services.

The dynamic processes of rapid urbanization, democratization and decentralization, and the development of primary health care systems that took place in Latin America during the past four decades have also shaped the Healthy Municipalities, Cities and Communities movement. Considering the Region´s stark health inequities and high poverty rates, the HMC movement shifted away from actions aimed at

disease prevention and sought to address the underlying social determinants of health and to improve quality of life (PAHO 2011). The emphasis on equity and social justice has helped to spur a vibrant HMC movement throughout Latin America, which resulted in the development of innovative public policies and participatory processes that are changing the way regional governments and civil society understand and promote health and quality of life (De Leeuw and Simons 2017).

2 Sustainable Development and the Importance of the Local Level

The key role of cities and local authorities to achieve sustainable development has been recognized by the international community, governments and organizations worldwide. Local authorities and mayors are in a privileged position to address the most pressing global health and environmental problems by spearheading policies and actions aimed at promoting sustainable development at the local level. Strengthening and supporting such leadership can be an important contribution of the HMC movement to the SDG agenda.

A HMC approach can support the development of healthy public policies focused on the social determinants of health, human and local development, sustainable environmental practices and health equity. As part of a HMC initiative, local governments can adopt planning and management mechanisms that foster multisectoral collaboration and participatory decision-making processes. These, in turn, can contribute to the implementation of measures that can bring about significant change in local social, economic, and environmental conditions and sustainability.

3 HMC Networks: Catalyzing the SDG Agenda

While HMC initiatives are present throughout the continent, various national and sub-regional HMC networks have also emerged. Countries with active networks include Argentina,[1] Brazil, Cuba, Mexico[2] and Peru. Recently, countries in the Region have come together and formed the Latin America Network of Health Promotion that has as one of its goals the strengthening of national HMC networks. At the regional level the HMC Network of the Americas, coordinated by the Pan American Health Organization facilitates the exchange of experiences among countries as well as the strengthening of the HMC movement.

[1]For more information on the HMC Network in Argentina, consult the website: http://www.msal.gob.ar/municipios/ (Available in Spanish only).

[2]For more information on the Mexican Network of Municipalities for Health, consult the website: http://www.promocion.salud.gob.mx/red/ (Available in Spanish only).

The networks that developed in Latin America present a variety of structures and leadership styles. In Argentina, Cuba and Mexico, for example, the Ministry of Health play a key role in shaping and sustaining their HMC networks. In Brazil, universities have assumed this role, while in Peru, the coordination of the network rests with a mayor's association. In contrast with the European Network of Healthy Cities, in Latin America, there are no pre-established criteria for the definition and recognition of a Healthy Municipality, City or Community. Some countries, such as Argentina[3] and Mexico have developed country-specific criteria and programs to certify and classify efforts taking place at the local level, while other have not.

National and regional HMC Networks can have a unique role in promoting sustainable development by supporting and strengthening HMC initiatives and their leaders and partners. These networks can support member cities and their region by strengthening capacities to implement sound and responsible social and environmental practices, orienting the agendas of local governments, facilitating the exchange of experiences, generating evidence and promoting the adoption of best practices. Investing in the development of HMC Networks can be a strategic action to help countries achieve the SDG as proposed by the United Nations.

4 Healthy Cities and the International Sustainable Development Agenda

During the Sustainable Development Goals Summit (September, 2015), mayors from 40 countries declared their commitment to the 2030 SDG agenda, and since then a series of mayor-led initiatives have been launched worldwide. The 2030 Agenda for Sustainable Development, a continuation of the Millennium Development Goals which will be discussed further along in this chapter, emphasizes the interconnectedness of the social, economic and environmental dimensions of life and how a healthy cities approach can contribute to achieving the Sustainable Development Goals, including SDG 11: Make cities and human settlements inclusive, safe, resilient and sustainable (UN 2015).

The 9th WHO Global Health Promotion Conference (WHO 2016) also highlighted the unique contributions of Healthy Cities movement to address the social determinants of health and improve the conditions and quality of life of populations worldwide. The Conference served as a platform to reaffirm the role of the Healthy

[3]For one example, the Argentinean Network of Healthy Municipalities has developed an accreditation system which considers 4 phases that municipalities need to complete in order to become a certified Healthy Municipality. This process is described in the Network's website: http://www.msal.gob.ar/municipios/index.php/informacion-para-municipios/como-sumarse-a-la-estrategia.html (Available in Spanish only).

Cities movement in promoting health and health equity, as well as environmental sustainability.[4]

5 Global Development Agendas: From the MDGs to the SDGs

The Millennium Development Goals (MDGs), spearheaded by the United Nations,[5] precedes the publication of the SDGs by the United Nations and their adoption by countries worldwide. The MDGs are historically significant in the evolution of international relations because they established a set of global goals that were to be achieved at all levels—international, national, regional and local—and which reaffirmed the commitment of governments and the international community to peace, human rights, democracy, environmental sustainability and, especially, the eradication of poverty.

Countries' commitment to meeting the MDGs was considered one of the most successful efforts against poverty, most notably from a political standpoint, even though part of the goals could not be achieved due to the socioeconomic diversity and complexity of signatory countries and regions, as well as of their states and municipalities. Overall, hunger and malnutrition, for instance, have declined, but not at an adequate rate for the goals to be attained. Deforestation and the trend toward an increase in greenhouse gas emissions continued. By the end of the millennium, it was clear that many challenges still had to be faced, such as the growth of social inequality in the world; unsustainable social and environmental practices; persistent discrimination because of race, ethnicity, sexual orientation and gender identity; as well as challenges related to youths and the inclusion of people with disabilities (Carvalho and Barcellos 2014).

At the end of the millenium, countries, in general—particularly developing countries—were focusing almost exclusively in increasing production, with a great share of power accumulating in the hands of entrepreneurs and promoters of economic policies, and usually associated with unsustainable environmental policies and redistributive social policies, aimed at social development and health that were focused on welfare and compensation (Gallo et al. 2012).

Therefore, the SDGs should be understood as a complementary mechanism to stimulate an adjustment to the development model, underscoring the need to transform the way we use resources and to reroute technological development and economic and social investments.

This new universal agenda demands an integrated approach towards sustainable development and collective action at all levels in order to face the challenges of our

[4]The conference material can be downloaded from: http://www.who.int/healthpromotion/conferences/9gchp/en/.

[5]Information on the MDGs can be accessed at: http://www.un.org/millenniumgoals/.

time, with the encompassing imperative of "not leaving anyone behind" and the major goal of taking inequalities and discrimination into account (UN 2016).

It is assumed that governance for sustainable development must assure more democratic, participatory, inclusive and efficient forms of government that place social, economic, environmental and health equity at the center of its results, highlighting the need to continue with the implementation of the principles included in the Agenda 21 and in related agendas such as the Healthy Municipalities, Cities and Communities (Buss et al. 2012).

To do that, it was established that the fulfillment of the global SDG targets would demand greater efforts from the most developed countries, differently from the MDGs, which focused excessively in the actions of developing countries. The SDGs Agenda, however, is an instrument to protect specifically the most vulnerable nations, with the goal of assuring the human right to safe food, access to water, sanitation, as well as decent jobs and labor, among others.

Establishing political coherence for sustainable development implies changing the focus from a sectorial approach to more integrated approaches, based on synergies between sectors. Moreover, there must be coherence between national and international norms in order for national efforts that follow international standards to be legitimate (OECD 2016).

6 Linking Agendas for the Implementation of the SDGs

The process of implementing the SDGs starts with the analysis and adaptation of this international agenda to population groups and communities that have different cultural references. Local and regional programs should be reviewed in order to identify the most important needs, priorities, gaps and intersectoral connections in the territories, as well as their relations with the SDGs and national priorities (PNUD 2016b).

One strategy to respond to this challenge, as stated earlier, is to adopt SDG 11 (on sustainable cities and communities) as a central axis associated to the urban dimension of other SDGs and related to government responsibilities, particularly with regards to basic services and the assurance of human rights, as well as with the social and environmental responsibilities of companies, with the support of universities and the civil society.

Therefore, national strategies must be aligned with the Agenda, integrating SDGs to the framework of national policies, with clear mandates, political planning at all levels, as well as the participatory monitoring and evaluation of its implementation.

In the preparation of the implementation of the SDGs, Sweden, for instance, organized a public inquiry involving approximately 200 people (representing approximately 130 civil society organizations, business associations, trade and political unions, as well as government agencies and other institutions). The goal

was to exchange knowledge with the most relevant actors, to share information regarding the negotiation of the Agenda in order to gather broad support for the implementation of the Agenda in the country (OECD 2016).

Another example is Finland's National Implementation Plan for the Agenda 2030, which consisted in a survey to establish which existing political instruments allowed for the implementation of the SDGs and which should still be created. The goals and targets—and through which policies (at the national European and international levels)—the Finnish government is implementing were identified. The survey pointed out the most relevant political measures and where to get the budget for it, as well as evaluated potential areas for intersectoral cooperation and other problems or insufficiencies (OECD 2016).

In Brazil, representatives of the federal government and other entities of the United Nations formed 16 theme groups with the goal of strengthening cooperation and developing activities in areas related with the sustainable development agenda. The partnership resulted in the identification of the most important social, environmental and economic indicators related to the SDGs (PNUD 2015) and the mapping of 65 projects introduced in the "Portfolio of UNDP Brazil Sustainable Development Goals Project" (PNUD 2016b).

The federal government created the National Commission for the Sustainable Development Goals, which included the participation of representatives from municipal, state and federal governments and of civil society with the goal of proposing strategies, instruments, actions and programs related to the implementation and monitoring of the SDGs (PNUD 2016a).

This process included an attempt to bring together public policies that contributed to the integration of the economic, social and environmental dimensions of sustainable development, such as: the National Health Promotion Policy, the National Urban Mobility Policy, the National Urban Health Plan, among other policies linked to the Agenda 21 and to the Social Determinants of Health, the Healthy Cities and the Sustainable Cities, which produce intersectoral arrangements in territories of different scales.

At the legislative sphere, the SDGs Parliamentary Front was launched to improve legislation for the implementation and monitoring of the global goals. Moreover, at the judiciary level, the Federal Court of Auditors adopted the SDGs as indicators for thematic assessments carried out by the court after a demand of the International Organization of Supreme Audit Institutions (INTOSAI) for the SDGs to be monitored (PNUD 2016a).

The public sector is not the only one considering the SDG Agenda; private companies have also been discussing the implementation of the SDGs in their operations through the Brazilian Global Pact Network. A study ("The integration of the SDGs into business strategies: contributions of the Brazilian Global Pact Committee to the Agenda 2030") showed that out of the 800 companies, 41% had already developed initiatives in line with the SDGs, and 35% were in the planning stage to adapt their operations to the new sustainable development agenda (RBPG 2017).

7 The Evaluation of the MDGs in Brazil from the Perspective of Agenda 21 and the Healthy Cities Initiative

Before discussing strategies for the implementation of the SDGs and their contribution to the Healthy Cities movement, the Agenda 21 or the Sustainable Cities initiative, we should mention previous experiences with the implementation of the MDGs, an ambitious agenda that ended in 2015 and that aimed at decreasing global social inequities. A total of 189 countries launched efforts to fulfill eight encompassing goals defined under the MDGs. Brazil—where some public institutions, at various government levels, monitor the implementation of the MDGs at the federal, state and municipal levels through indicators specifically developed or adapted for that—was one of these countries.

The MDGs referred to important aspects that should be the object of actions dedicated to fighting poverty and hunger, promoting education (especially of children) and gender equality, improving health conditions and the access to basic sanitation and housing, as well as advancing sustainable development and social inclusion. A research center of the Ministry of Planning—the Institute for Applied Economic Research (IPEA)—was responsible for evaluating the agenda at the national level and was able to establish methods for evaluating its impact, despite a few flaws on the databases.

At the level of the municipalities, the MDG Portal was maintained with general information. However, beyond that, few evaluations were conducted, probably because the data necessary to produce indicators at that level were incomplete.

A Multicenter Study—coordinated by the School of Public Health of the University of São Paulo with the participation of the Paraná Catholic University, the Federal University of Goiás, the Dom Bosco Catholic University, the Pernambuco Federal University, the University of Amazon and the Tocantins Federal University and the support of the Center of Studies, Research and Documentation in Healthy Cities (CEPEDOC)—was developed with the goal of evaluating whether and how different agendas—such as Healthy Cities (more linked to the health sector) and the Agenda 21 (supported by the Ministry of the Environment), both of which implemented in the country since the 1990s—contributed to the fulfillment of the MDGs in different municipalities of 5 regions in the country.

It had been assumed that, even though it had emerged from the global environmentalist movement, the Agenda 21 went beyond its sectoral boundaries. Starting in 2003, the Agenda 21 was adopted as a public policy by the Brazilian Ministry of the Environment, which established a decentralized funding scheme (that still exists) for its implementation at the local level, emphasizing the use of participatory strategies. We have already spoken of the Healthy Cities agenda, stimulated by the World Health Organization and its American counterpart, at the beginning of the chapter.

The premises for this study were that: (1) the development promoted by the local development agendas protect living, health and environment conditions and

potentialize their improvement since they affect the social and economic determinants of health; (2) the impact and the results of the development promoted by local development agendas such as the Agenda 21, the Healthy Cities and others are supported by the following action principles: holistic conceptual framework, intersectorality, empowerment, social participation, equity, multi-strategic actions and sustainability.

In other words, based on the literature, it was assumed that the projects would change local public policies dedicated to solving problems through the participation of the population in the decision-making process, which, in turn, would also become more transparent, as well as promote a greater level of trust between the government and the civil society.

The expected result of all the process that involved the cities that adopted these agendas was a form of social development that would promote health and social equity. Health, therefore, would also be promoted by tackling its social determination, a thesis that is widely disseminated by scholars and epidemiologists from Brazil (Ayres 2002; Buss and Pellegrini Filho 2007) and abroad (Breilh 2006; Dacks 2002; Drachler 2003).

The multicenter study of cities that developed projects related to the Healthy Cities initiative and the Agenda 21 in Brazil used a sequential, exploratory design for collecting and analyzing data (Creswell and Clark 2007) and was carried out in three stages.

In the first stage, an exploratory study was carried out to update the register of social development agendas through the mapping of social agendas. Documents were evaluated and phone interviews carried out to confirm information. Then, municipalities that had at least three years of experience with the development of the agenda were selected. During the second stage, a cohort, case-control study of a few agendas that had been implemented in different regions in the country was carried out to show whether the existence of social agendas in such municipalities improved living and health conditions, as measured by MDG indicators. In the third stage, case studies were carried out in the five regions of the country, analyzing the development of the agendas in the municipalities and the participation of the government and the civil society. Other issues were also evaluated: the local social networks and their interfaces and potentials regarding integrated, participatory management schemes; the sustainability of public policies dedicated to social development; the protection and preservation of the environment; and the promotion of health.

The results can be analyzed differently for each stage. In the first stage, it was identified that 105 municipalities had been developing social agendas like the Agenda 21 and the Healthy Cities initiative for at least three years. Interestingly, such protective agendas were very concentrated in the Southeast and South of the country, to the detriment of other regions.

Figure 1 shows, on the left, the geographic distribution of the 105 municipalities that met the criteria for participating in the study, and, on the right, a map that seeks to evaluate qualitatively the concentration of the agendas in the different regions of the country.

Fig. 1 Geographic distribution of the 105 municipalities that met the criteria for participating in the study, Brazil, 2009

The data on Fig. 2 shows that equity-promoting agendas occurred mostly in the South and Southeast, the most developed regions in the country. It shows that the instrument had not been incorporated by the poorest regions in the country, only by the most developed, with few exceptions.

Stage two consisted of a longitudinal ecological study to evaluate the impact of programs, comparing municipalities that developed agendas with others that didn't at three different moments: at the year of the beginning of the program and three and six years after. The goal was to show whether there was a relation between the existence of social agendas and improvements in living and health conditions in these municipalities, measured by MDG indicators. The list of indicators was established based on the list used by the Institute for Applied Economic Research (IPEA) to monitor these indicators at the national and state levels. Such indicators mixed those selected by the United Nations and others that were more adequate to

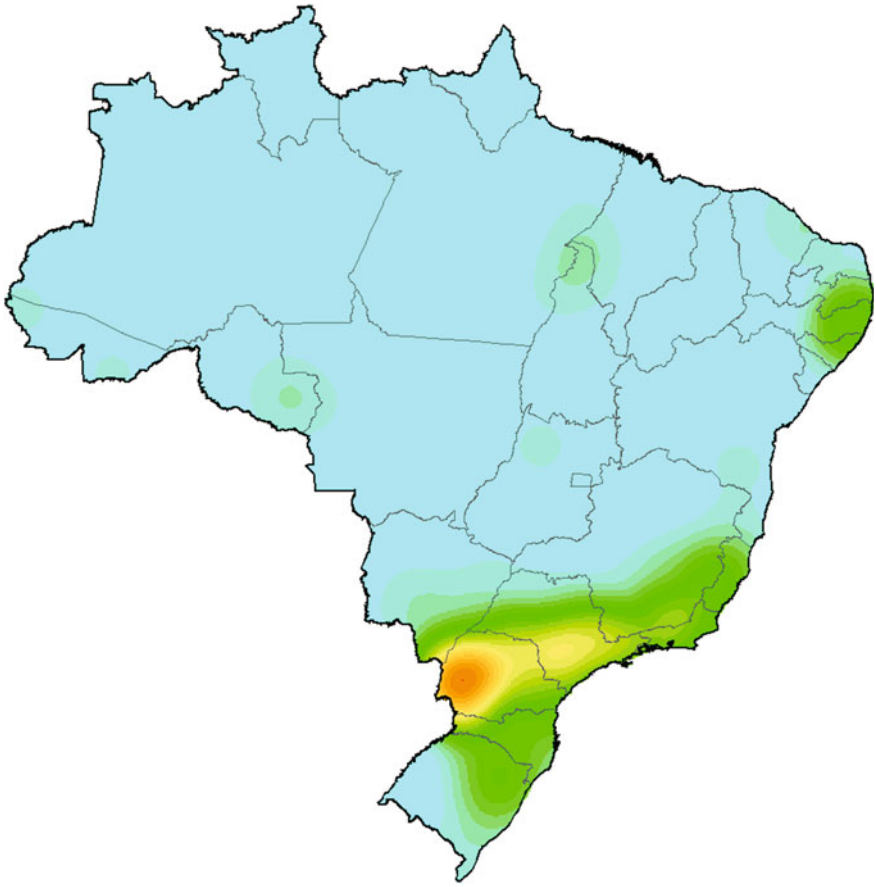

Fig. 2 Map of intensity of concentration (Kernel-intensity) of municipalities selected for the study. Brazil, 2009

evaluate the Brazilian reality, considering the availability of information. Soon it was realized that another selection would be necessary, given that a large scope of indicators was only available at the national and regional levels and that these databases were not consistent with the municipal databases.

Finally, 29 indicators were selected to evaluate living and health conditions. One hundred and five municipalities in the five regions of the country were involved with social development agendas and were selected as an "exposed" group to the effective experience and 175 municipalities that did not implement the agenda (non-exposed) were selected as a control group, more or less two controls per municipality.

According to Nascimento et al. (2014), the impact of the agendas was detected in a few indicators such as a reduction in hunger and an increase in the universal access to education, but, generally speaking, it was verified that information, at the

municipal level, is very hard to obtain with the necessary regularity needed to prove the effect of the development agenda as proposed by the study. Moreover, it was concluded that three years is a very short period to show any actual change and, at the six year mark, a large number of municipalities had stopped carrying out the agendas. Results also indicated that compound indicators and the use of qualitative methodologies would also be necessary to complement and illustrate the numbers presented in the third stage of the study (Westphal et al. 2011; Nascimento et al. 2014).

The goal of stage three was to analyze public management and the relations established between the actors and the institutions in the development of the social agendas. It was questioned whether these social agendas were developed in a collectively, intersectoral and participatory way and whether they promoted the autonomy of individuals and communities and the social equity of the territories where they were developed. Other issues were also evaluated: local social networks, their interfaces and potentials regarding integrated, participatory management schemes, as well as the sustainability of local public policies that promote health and a better quality of life. Not all 105 municipalities studied in stage 2, were included in stage 3. Twenty-four municipalities from all regions of the country were selected—with at least 3 years of implementation of the agenda and the best living and health conditions. The researchers selected case studies after a process of "cluster analysis" using 19 variables and other criteria that assured that municipalities from all regions and all sizes and, preferably, non-state capitals had the same opportunity to be included. The municipalities selected are listed in Table 1.

The data from selected municipalities was collected through semi-structured interviews, documents and field observations. The number of interviews varied from 5 to 20 depending on the suggestions of key informers and other interviewers. The saturation of information was the determining criterium for the number of interviews carried out in each municipality. All were recorded, transcribed, analyzed, compared with secondary data and triangulated.

The issue of participation has strongly present in the national political discourse since the transition to democracy in the 1980s. Considering the data obtained by the study in the country's various regions, it may be inferred that the social agendas evaluated have indeed corroborated that since participation was also highlighted as one of their pillars. Interviews included recurring references to participation, which suggested that the premise had been embraced. Participation was always mentioned as having intrinsic value and as a facilitator of the capacity-building processes of participants. The relevance of participation was highlighted by respondents while mentioning the process of implementation of the agendas, the methodology in particular and the results they observed.

Sustainability, another premise in these social agendas, also seemed to have been embraced by participants in the experiences studied. Since most of these agendas were related to the Agenda 21, sustainability was recurrently mentioned in the interviews. Some municipalities used strategic planning to prepare a long-term development plan for the municipality that did not depend on municipal authorities: they made diagnostics and projected future scenarios.

Table 1 Municipalities selected for Stage 3

Region	State	Municipality
Central West	Mato Grosso do Sul	Campo Grande
North	Pará	Altamira
		Rondon do Pará
	Rondonia	Ministro Andreazza
	Acre	Mancio de Lima
	Tocantins	Sampaio
Northeast	Pernambuco	Olinda
		Cabo de Santo Agostinho
		Barra do Guabira
		Bonito
	Rio Grande do Norte	Grossos
	Alagoas	Arapiraca
South	Parana	Cascavel
		Marechal Candido Rondon
		Pranchita
	Rio Grande do Sul	Rio Grande
	Santa Catarina	Bombinhas
		Joinville
Southeast	Espirito Santo	Vila Velha
	Miinas Gerais	Nova Era
	Rio de Janeiro	Macaé
	São Paulo	Americana
		Pedreira
		Piracicaba

A Public Interest Civil Society Organization—whose members included local entrepreneurs, a university and centers of excellence, which formed a network of social support—was able to help the municipal government in the development of a ten-year plan. For most of the projects, however, the idea of sustainability was expanded beyond the environmental scope, including the continuity between policies and agendas. During the interviews, issues such as the concern with the conservation of natural resources for future generations, as well as the discontinuity of public policies, were also highlighted. Political partisanship often hindered the implementation of guidelines and/or plans developed in participatory processes.

Transparency in public management was highlighted mostly in the Southeast. In the other regions—by force of the model suggested for the implementation of the Agenda 21—the idea of social control predominated, especially in Olinda and Campo Grande.

The alignment of the many experiences regarding participation, sustainability and transparency suggests that the agendas promoted the transformation of the

political culture, which would intensify the democratization that has taken place in the country over the last few decades.

As to networking, the inclusion of municipalities in the Network of Potentially Healthy Municipalities—or those that function as a network such as the Agenda 21 of Piracicaba—in the development of a social network has been improving the sustainability of the strategy, assuring its implementation despite changes in the government.

8 Recommendations for the Implementation of the SDGs at the Local Level

Since regions in Brazil are very different from one another, it was very hard for researchers to statistically show whether the existence of social agendas in the municipalities could change these societies. The quantitative study was not able to obtain objective data to prove changes. Qualitative analyses showed that many of the experiences were at least able to create work groups, involve people in participatory processes in which they could strengthen their citizenship and positively contribute to their municipality´s development. However, the analysis also showed that the repetition of patterns is so powerful that these agendas and the will to change things often succumbed.

Only the Agenda 21 had the economic support of the federal and state public spheres. Therefore, many experiences were taken on only by the local government, and only when both the civil society and the government showed a lot of will to change the local reality.

Networks of cities, such as Healthy Cities or Agenda 21 could provide support for the implementation of the SDGs. In Brazil—after an initiative of the Our São Paulo Network, the network for Fair and Sustainable Cities and the Ethos Institute—the Sustainable Cities Program offers a platform that serves as an agenda for sustainability, incorporating the different SDGs into 12 themes related to different areas of the municipal public administration. A total of 421 mayors of all regions in the country signed the Letter of Intent of as part of their association with the Sustainable Cities Program for mayors and political parties (RNSP 2017).

For the SDGs to be implemented, it is crucial that local governments are supported by state and national governments and that they establish a multilevel governance scheme based on mechanisms that strengthen the capacities of local governments, social movements and the civil society concerning SDGs, developing their abilities as to potentialize their contributions, despite limited competencies. Governance must also stimulate the commitment and involvement of the private sector in establishing partnerships with various interested parties or stakeholders concerning the social and environmental accountability of companies.

Therefore, integrated, multilevel governance approaches must promote participatory, intersectoral monitoring and evaluation processes involving local managers,

social movements, the civil society, the private sector, partnerships and formal and informal networks, which are required to substantiate the effectiveness of policies regarding the social and environmental determinants of health.

Strengthening competencies and capacities for action at the local level is also critical to the successful implementation and attainment of the SDG Agenda. The SDGs define targets directly related to the responsibilities of local authorities and decision makers. The achievement of these targets depend on the capacity of stakeholders to promote integrated, inclusive, intersectoral and sustainable local development. The HMC Strategy places strong emphasis on mobilizing stakeholders and strengthening local political leadership. As such, the HMC strategy offers an important platform to support the alignment of local plans and the SDG agenda.

To support this alignment, it is important to develop practical tools and mechanisms to orient and facilitate the planning and implementation of the SDGs agenda within the framework of an HMC initiative. These tools must be concrete yet flexible enough in order to be adapted to local contexts and needs.

HMC Networks and PAHO/WHO Collaborating Centers can be powerful allies in these efforts. Some of the activities they can realize include the review of existing HMC tools, the systematization of relevant experiences and best practices, and the summarization of findings and evidences to support policymakers, local authorities and local actors in their efforts to design, implement and monitor actions that are aligned with the SDG Agenda and the HMC strategy.

One fundamental point to successfully integrate de SDGs into local development plans is to raise awareness of the 2030 Agenda among local actors, emphasizing its importance to address local and national challenges, as well as the key role these actors can play in its achievement. National and international organizations, national and sub-national governments, academia, researchers, and HMC networks have an important role to play in such advocacy and can help to set-up the appropriate platforms to connect with the local level.

Social participation in the decision-making process is one of the pillars of the HMC approach and is also key for the achievement of sustainable development goals. Empowering local communities and stakeholders therefore is an important goal to make local agendas more responsive, relevant and committed to local development issues. This emphasizes the importance of supporting the implementation of consultative and participatory mechanisms at various levels that allow for the inclusion of various stakeholders' perspectives and promote ownership, commitment and accountability of the decision and actions taken. Examples include the establishment of intersectoral or interdisciplinary committees, the use of participatory methodologies for planning and execution of interventions, the creation of communities of practices, the promotion of dialogue and public debates through forums and community meetings, among others. Existing HMC resources which provide orientations on the implementation of participatory methodologies can be adapted and support these processes in the course of the implementation of the SDGs.

Challenges in the Brazilian current political and economic situation highlight the need for an urgent, pressing change: strengthening the empowerment of cities through their government officials, leaders and managers. The significant presence of the SDGs, the Brazilian initiatives uniting universities that support the movement for the reinvention of cities and the governmental and non-governmental organizations involved in city issues that advocate a new agenda for municipalities should all unite to catalyze the emergence of a productive and innovative atmosphere of support for ongoing or planned initiatives. In this context, it is imperative to consider actions that go beyond the territories of cities—such as legal norms and regulatory procedures, financing rules and technical assistance that are based on the monitoring and evaluation of ongoing experiences—which, together, would improve the management of municipalities and the quality of life of their citizens.

The experience of evaluating municipal projects involving cities with the support of universities was a great, recent step and can inspire new initiatives adapted to the new Brazilian context in which many mayors have shown interest in getting involved with the implementation of the SDGs, which in turn could improve the management of the municipality and the life of our citizens.

9 Conclusion

Nowadays, the global development agenda strongly emphasizes the need to empower cities to lead the way to sustainable development. It is recognized that cities are at the front line of the most important challenges for sustainable development. However, while blunting the direct consequences of the social, health and environmental problems affecting their population, cities are also at the forefront to address them in a sustainable matter.

Lessons from the Brazilian implementation of the Agenda 21, MDG Agenda and the HMC strategy underline the importance of local governments and local actors in fulfilling the sustainable development agenda. The multicenter study discussed in this chapter highlights that the development of social agendas such as Healthy Cities and the Agenda 21 can positively influenced the reality of municipalities; therefore, municipalities should invest in such agendas. The SDGs have been showing potential to link national and international equity-promoting agendas and to be incorporated into public policies that are based on the true needs of their territories.

The networks of the Healthy Cities and the Agenda 21—and others alike—may play a crucial role in the implementation of the SDGs, given their capillarity and capacity to mobilize actors at different levels, as well as strengthening communities in their abilities to promote sustainable actions through training and the sharing of experiences. Investing in the development and strengthening of these networks and their capabilities can therefore be an important strategic investment for the successful implementation of the SDG agenda.

The HMC Strategy, with its focus on catalyzing local political leadership and mobilizing stakeholders, can serve as a platform to contribute to alignment of the SDG agenda and local plans of action. It offers a key opportunity to promote significant and wide reaching changes to the way municipalities, cities and communities address sustainable development challenges and gear their action towards meeting the SDG agenda.

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Sustainable Development Goals as a Framework of Education for Healthy Cities and Healthy Environments

Marija Jevtic and Catherine Bouland

Abstract Today, when more than half of the world's population lives in urban areas, foreseeing that by 2050 practically 70% of the population will be living in urban areas, it is obvious why cities and urban health are placed on the very top of the Priority Agenda among the major challenges for our survival and quality of life. Cities and urban areas are the focal point of different fields, health professionals included, enabling to solve short-term problems, and, more importantly, long-term management of the urban environment challenges. New circumstances regarding demographic facts in combination with climate change, migration, uncontrolled urbanization, raising inequality and also basic needs of clean air, water, safety food and energy needs, and increasing contamination, but also information era, lead to think about new perspectives of education and innovative possibilities for human species in the world. Sustainable development goals should not remain only wishful thinking, we have to undertake a holistic approach to achieve a sustainable future for the new generations. The role of public health professionals is to merge health expertise with non-medical expertise making public-health action possible and achievable. The process of changing is faster than predicted. There is no unique recipe for different urban areas and human agglomeration. In this paper, we give our common views from different perspectives (Belgium and Serbia). Exchanges of different experiences and stories about challenges support a way to common sustainable future.

Keywords Sustainable development goals · Education · Urban health
Healthy cities · Healthy environments

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1 Introduction

The human population on the planet is increasingly approaching the figure of nine billion people. The population growth is neither balanced nor harmonised with the living conditions in different areas of our planet. The population distribution and density is influenced by several factors among those: societal, economic, social, religious, and others. Overall consumption is increasing in parallel to population growth. Aimed at the development of infrastructure, energy supply required for human activities, and, consequently, provision of economic opportunities and jobs for the population, urban areas are attractive for life of individuals and populations, but at the same time, there are growing and new risks for individual and population health.

Considering the fact that by 2050, 70% of the human population will be living in cities, urban areas are clearly brimming with challenges, but, nevertheless, they are also the places where challenges are, should and will have to be solved. Urban health is, in a certain way, both a response and a new arising discipline that attracts special attention with, among other things, one major goal: maintenance and development of urban infrastructure, together with the reduction of climatic change contribution and the preservation of population health (UN 2014).

Due to the evident agglomeration of the human population in urban areas, health is not only a goal for an individual but also for the population and/or the wider community. Bearing in mind the complexity of the relationship between man and the constructed environment where population congregates, we can talk about urban ecosystem urban health as well. It is this new living environment—a combination of nature and the newly constructed for the purposes of economy and to satisfy the desire for a better quality of life—that makes cities a kind of a new organism on our planet.

The aim of this chapter is to demonstrate how to use sustainable development goals in Lifelong Learning and Education process to make cities more Healthy and Sustainable. This is important not only for future health professionals, but also for all the other professionals who are involved in the development of the city and could therefore contribute to a healthier urban environment.

2 Healthy, Sustainable, Smart, Green Cities: Different Concepts

Out of a desire to respond to urban area challenges, several concepts have been developed, aimed at improving urban health and preservation of health in cities: healthy cities, smart cities, green cities, sustainable cities, resilient cities etc. (WHO 2000).

Each of these concepts of city's development has a distinctive feature, which either corresponds to specific urban areas, or, emphasises an infrastructural

component, a city's feature or a developmental direction focused on by the given urban area. Ultimately, there is a common motive behind all the components—health preservation and health improvement not only of people, but also of the environment as such (both natural and constructed), that is, urban area as a specific entity.

According to the World Health Organization (WHO) experiences, in the development of Healthy Cities projects, urban health improvement actions are more successful if the overlapping of activities is avoided and the coordination of stakeholders is established. That is when cost-effective solution, synergy and distribution of resources can be expected (WHO 2000). WHO has provided several guidelines for the development of the Healthy Cities project, using the experiences from different regions worldwide. There is no uniform model, but a starting point which can be applied and adapted to the local circumstances (WHO 2000).

In their paper *Shaping cities for health: complexity and the planning of urban environments in the twenty first century*, Yvonne Rydin and collaborators give a key message that "cities are complex systems, so urban health outcomes are dependent on many interactions" (Rydin et al. 2012). "*Healthy cities*" and "*healthy environment*" are goals to be pursued with the clear limitation and understanding that it is impossible to remove all risks, seeking to reduce them to the absolute minimum.

The key stakeholders in the process are definitely many, among those we find citizens, local, regional, state and national decision-makers, service providers from various sectors (health, transport, police, utilities, and others), civil society and various associations, private entrepreneurs, consumer's associations, local self-management bodies, representatives of authorities, ethnic groups, media, as well as institutions of education (UN HABITAT 2016).

Human health in cities is affected by the functioning of all the individual segments (stakeholders). Therefore, it can be said that health is closely linked to urban development. Positive urban development contributes to the development of health, and vice versa, a healthy population contributes to the development of a city. The connection between heath policies and urban strategies, as well as other major issues of relevance for heath and city development plans, is very intense, and decisions are to be reached as a result of re-examination of this interrelationship (WHO 2000).

The urban features relevant to the action planning for the development of a "healthy city" are: topography, climate, history, culture, administrative structure, demography, transport, as well as other infrastructural components. Among other points of importance are the data on the health of the population, on the environment, on the organization of public health, on the institutions of education, etc. It is necessary to define mechanisms for the implementation of the planned activities, monitoring and evaluation, as well as the needed human resource capacities (WHO 2014).

The urban planning process provides an opportunity for the development of a city vision and participation of its citizens, professionals and decision-makers in different activities within the community, as well as an advancement of the concepts of healthy, green, smart, sustainable, resilient cities.

According to World Urbanization Prospects, "*successful sustainable urbanization requires competent, responsive and accountable governments charged with the management of cities and urban expansion, as well appropriate use of information and communication technologies, and also a need for building institutional capacities and applying integrated approaches to urban sustainability*" (UN 2014).

3 The UN Sustainable Development Goals (SDG) and Their Timeframe

The SDGs are envisaged as a United Nation's call for action to eradicate poverty, protect the planet and ensure conditions for people's peaceful and prosperous life, as well as a framework of actions to transform the world towards a more sustainable one. The States, the civil society and the industrial sector, together with the UN, would mobilize efforts for reaching sustainable development by 2030. The SDGs, adopted as a document in 2015, concern all countries, seeking to improve the lives of people everywhere (UN 2015a, b, c). Each of the listed 17 SDGs has its specific targets framed in time until 2020 or 2030. They need the involvement of a large variety of professionals to be fully implemented. This means that professionals from various fields will have to work together to the active implementation of the Goals and their intermediate and final Targets. On the other hand, it is clear that several generations of children will be going through the process of education during the period of the SDGs achievement (or non-achievement). It is emphasized that the SDGs are to be seen as a whole, so whenever actions are taken to achieve one goal, possibilities of producing an effect on the achievement of other SDG have to be taken into consideration (Table 1).

The Paris Climate Change Agreement is another important document of global relevance, adopted at 2016 (during COP21— the Paris Climate Conference). It will influence the achievement of specific SDGs.

4 SDGs and Connection to Urban Health and Population Health

Even though the human population has not existed since the very beginning of our planet, it has been there long enough to influence its trajectory. Extremely numerous, the population has increasingly grown over the last 100 years and made a huge impact on the appearance of the planet of Earth—it has affected processes on our planet, energy use and produced material goods.

The Millennium Development Goals were substituted by the SDG, with 17 goals (Table 1). The WHO report focuses on the period since 2000, analysing the achievements and providing an overview of the main challenges in the next

Table 1 Sustainable Development Goals (United Nations 2015a, b, c)

The SDGs, according to the adopted United Nation's document, (United Nations, General Assembly, 2015):	
1.	End poverty in all its forms everywhere
2.	End hunger, achieve food security and improved nutrition and promote sustainable agriculture
3.	Ensure healthy lives and promote well-being for all at all ages
4.	Ensure inclusive and equitable quality education and promote lifelong learning opportunities for all
5.	Achieve gender equality and empower all women and girls
6.	Ensure availability and sustainable management of water and sanitation for all
7.	Ensure access to affordable, reliable, sustainable and modern energy for all
8.	Promote sustained, inclusive and sustainable economic growth, full and productive employment and decent work for all
9.	Build resilient infrastructure, promote inclusive and sustainable industrialization and foster innovation
10.	Reduce inequality within and among countries
11.	Make cities and human settlements inclusive, safe, resilient and sustainable
12.	Ensure sustainable consumption and production patterns
13.	Take urgent action to combat climate change and its impact
14.	Conserve and sustainably use oceans, seas and marine resources for sustainable development
15.	Protect, restore and promote sustainable use of terrestrial ecosystems, sustainably manage forests, combat desertification, and halt and reverse land degradation and halt biodiversity loss
16.	Promote peaceful and inclusive societies for sustainable development, provide access to justice for all and build effective accountable and inclusive institutions at all levels
17.	Strengthen the means of implementation and revitalize the global partnership for sustainable development

15 years, until 2030 (WHO 2015). A separate WHO document includes 34 different topics and trends and offers strategic priorities for the improvement of health. It envelops various fields such as air pollution, transport, injuries, sanitation, water supply, etc. (WHO 2016).

According to WHO, the SDGs integrate all three sustainable development dimensions: economic, social and environmental. The inextricable links are emphasized between eradication of inequality and poverty and creation of inclusive economic growth. Health is, in a certain way, the central goal—represented in Goal 3—Wellbeing. Following this central Goal's achievement requires the harmonization of monitoring, appropriate data collection and integrated communication. Health situation monitoring implies the simultaneous monitoring of social, economic and environmental indicators, as well as cross-sectoral activities. Moreover, in all other Goals the health dimension must not be neglected.

5 The SDG Analysis and Their Use as a Framework for Education

The key words in this chapter are sustainability, education and health. One of them, is exclusively associated with the human, it is education. The other 2 key words—sustainability and health—do not refer to human population alone. Sustainability is associated with development, urban and wider, all the way to global development. Can the planet be sustainable even without human population? Perhaps, in our time, it is a philosophical and theoretical question. Can the planet be "*healthy*" even without human existence on it? Perhaps, the answer to both questions is affirmative, but the situation on our planet today is not so simple, and we, as humans, exist, want to live and keep on living. At the same time, we behave as master of the world, endangering our habitats, so the alarm for taking an action towards sustainability has been on for a while.

The core idea of an integrative approach to the SGDs as an educational framework for healthy cities and healthy environment consists of linking Goals 11, 4 and 3, together with Goal 13, but also with all other Goals somehow united as a whole in Goal 17, referring to the uttermost needed partnership in reaching each and all the Goals (Fig. 1).

6 SDG 11—Make Cities and Human Settlements Inclusive, Safe, Resilient and Sustainable

The facts previously mentioned that the majority of the human population today living in urban areas, and that by 2050 more than one third of the world population will be living in urban areas, put in the foreground Goal 11, which states that cities and human settlements are to be made inclusive, safe, resilient and sustainable (UN 2015a, b, c).

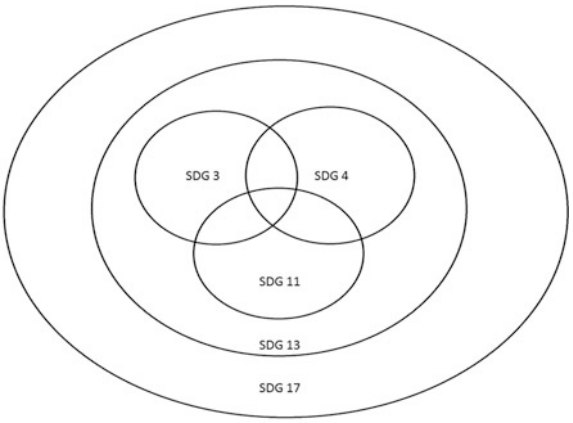

Fig. 1 The core of integrative approach to the SGDs as an educational framework

The achievement of Goal 11 foresees to ensure, by 2030, access for all to adequate, safe and affordable housing and basic services, and upgrading slums. Moreover, it is needed to provide access to safe, affordable, accessible and sustainable transport systems for all, improve road safety, notably by expanding public transport, with a special attention to the needs of those in more vulnerable situations (women, children, persons with disabilities and older persons).

It is necessary to work on enhancing inclusive and sustainable urbanization and capacity for participatory, integrated and sustainable human settlement planning and management and strengthening efforts to protect and safeguard the world's cultural and natural heritage.

In addition, among the targets to be achieved by 2030 within Goal 11, it is to significantly reduce the number of deaths and the number of people affected by disasters, and to substantially decrease the economic losses caused by disasters, including water-related disasters, with a focus on protecting the poor and people in vulnerable situations.

By the end of 2030, it is necessary to reduce the adverse environmental impact of cities, including by paying special attention to air quality and waste management, and to provide universal access to safe, inclusive and accessible, green and public spaces, in particular for women and children, older persons and persons with disabilities. Although many initiatives have taken place at city level such as healthy, green, smart, sustainable, resilient … cities, coordination and harmonisation has to take place to benefit from the good practices already developed and to go beyond. There again education is an interesting tool to activate.

Goal 11 supports positive economic, social and environmental links between urban, peri-urban and rural areas by strengthening national and regional development planning. It also supports adopting and implementing integrated policies and plans towards inclusion, resource efficiency, mitigation and adaptation to climate change, resilience to disasters, and development and implementation of a holistic disaster risk management at all levels. Although the SDGs refer to all countries and regions, it must be emphasized that special support is given to low income and developing countries, through financial and technical assistance in building sustainable and resilient buildings utilizing local materials.

7 SDG 3—Ensure Healthy Lives and Promote Well-Being for All at All Ages

Actualization of this Goal and its Targets are predominantly linked to the field of healthcare, but their implementation depends on urban areas, healthcare organization in cities and sustainability of healthcare systems.

Reducing the global maternal mortality rates; reducing deaths of new-borns and children under 5 years of age; ending the epidemics of AIDS, tuberculosis, malaria and neglected tropical diseases and combating hepatitis, water-borne diseases and other communicable diseases; reducing by one third premature mortality from

non-communicable diseases through prevention and treatment; promoting mental health and well-being, are among the Targets, for which preconditions are a better organization and infrastructure of healthcare and urban area in general (UN 2015a, b, c).

Prevention and treatment of substance abuse, including narcotic drug abuse and harmful use of alcohol, as well as reduction of the number of injuries and deaths from road traffic accidents are also predominantly located in cities.

Universal access to sexual and reproductive healthcare services, including family planning, information and education, as well as the integration of reproductive health issues into national strategies and programmes is also closely related to urban environments.

Universal health coverage, including financial risk protection, access to quality essential services in the domain of healthcare, and access to safe, effective, quality and affordable essential medicines and vaccines for all necessitates special engagement on the part of urban area, without undervaluing the importance or rural areas.

Reduction of the number of deaths and illnesses from hazardous chemicals and air, water and soil pollution and contamination is associated with industry, therefore, with cities, where industries are usually located. The same goes for strengthening the implementation of the WHO Framework Convention on Tobacco Control (WHO 2003).

Support to the research and development of vaccines and medicines for the communicable and non-communicable diseases that primarily affect developing countries, access to affordable essential medicines and vaccines to protect public health, and, in particular, providing universal access to medicines is especially important for large urban areas where substantial segments of population are combating poverty.

Increasing health financing, as well as the recruitment, development, training and retention of the health workforce in the cities of developing countries is of a particular importance. Strengthening the capacity of all countries, low income and developing countries in particular, for early warning, risk reduction and management of national and global health risks, and/or increasing resilience, is particularly relevant for cities (UN 2015a, b, c). It is the same preamble when one speaks of "Health in all policies" (Leppo et al. 2013).

8 SDG 4—Ensure Inclusive and Equitable Quality Education and Promote Lifelong Learning Opportunities for All

Ensuring that all girls and boys successfully complete free (affordable), equitable and quality primary and secondary education, leading to relevant and effective learning outcomes, is an important Goal that enables the development of all other Goals.

Moreover, among the Targets is ensuring that all girls and boys have access to quality early childhood development, care and pre-primary education so that they are ready for primary education.

This Goal includes equal rights for all women and men to affordable and quality technical, vocational and tertiary education, including university, which, among other things, will contribute to increasing the number of youths and adults who have relevant skills, including technical and vocational skills, for employment, decent jobs and entrepreneurship.

Elimination of gender disparities in education and ensuring equal access to all levels of education and vocational training for the vulnerable, including persons with disabilities, indigenous peoples and children in vulnerable situations, together with achieving the highest possible level of literacy and numeracy is one of the aims of this Goal (UN 2015a, b, c).

A particularly important Target for the topic at hand is to ensure that all learners acquire the knowledge and skills needed to promote sustainable development, including, among others, through education for sustainable development and sustainable lifestyles, human rights, gender equality, promotion of a culture of peace and non-violence, global citizenship and appreciation of cultural diversity and of culture's contribution to sustainable development.

Education facilities are to be suitable for the needs of children and people with disability; they should be gender sensitive and provide safe, non-violent, inclusive and effective learning environments for all.

An increase is needed of the number of scholarships available to developing countries—in particular least developed countries, small island developing states and African countries—for enrolment in higher education, including vocational training and information and communications technologies, technical, engineering and scientific programmes, in developed countries and other developing countries. It is necessary to increase the supply of qualified teachers in developing countries, in least developed countries and small island developing states (UN 2015a, b, c).

An integrative approach in the process of education (through inclusion of all) is a precondition for the achievement of all other Goals, since knowledge is necessary for understanding the process and taking a decisive well-founded action.

9 SDG 13—Take Urgent Action to Combat Climate Change and Its Impact

Adhering to the United Nations Framework Convention on Climate Change, which is a primary international and intergovernmental forum for negotiations on forms of global response to the climate changes, as well as the 2015 Paris Agreement (UN 2015c), strengthening is needed of the resilience and adaptive capacity to climate-related hazards and natural disasters, which is particularly relevant to large agglomerations—cities.

What needs to be done is to integrate climate change measures into national policies, strategies and planning, as well as to improve education, raise awareness and enhance human and institutional capacity in regard to climate changes through mitigation, adaptation, impact reduction and early warning (UN 2015a, b, c). Several initiatives are taking cities en route to address Climate Change, C40 among others, the spread of such initiatives and success would also raise the awareness among decision-makers (C40&ARUP 2015).

Therefore, the challenges of a sustainable urbanization under the influence of climate changes are the focus of numerous professionals, whose aim is to ensure a safe future for the generations to come, with understanding of the needs in ensuring energy (from renewable sources), sustainability of all systems (healthcare and education being of paramount significance), as well as enhancement of their resilience.

10 SDG 17—Strengthen the Means of Implementation and Revitalize the Global Partnership for Sustainable Development

This Goal focuses on Targets referring to partnership among countries, both developed and developing, adoption and implementation of investment promotion regimes for least developed countries, promotion of the development, transfer, dissemination and diffusion of environmentally sound technologies to developing countries on favourable terms, which is closely linked to development of cities (UN 2015a, b, c).

Enhancing the global partnership for sustainable development, complemented by multi-stakeholder partnerships that mobilize and share knowledge, expertise, technology and financial resources, in order to support the achievement of the SDG in all countries, in particular developing countries, is also predominantly relevant to urban areas, without undervaluing the importance of rural ones (UN HABITAT 2016).

Partnership among countries does not exclude partnership among cities and regions, and all partnerships should be utilized for strengthening capacities for the achievement of the SGDs both at the global and local level, through education, health improvement and concepts of healthy, sustainable, resilient and smart cities.

11 Role of Education in the Achievement of the SDGs and Urban Health

Cities today suffer from major exposure to health risk (urban health), and the consequences of the inability to maintain balance and healthy urban environment presents a motive to look at educational processes as a possible avenue for finding a remedy.

Our deliberation starts from the fact that more than half of the world population today lives in cities and that this growing trend is continuing, which means that the population will keep agglomerating in cities. Among the reasons for both the desire to move to large centres and to live in urban environment are educational opportunities and healthcare services availability. Life in urban areas, however, intrinsically involves exposure to new risks to health preservation and improvement. Thus, by some of its features, urbanization becomes an advantage, and by others, a disadvantage and/or risk (Jevtic 2011).

If education is viewed as the key for achieving sustainability, several important facts must be taken into consideration. Changes and swift twists and turns in the way of life based on new technologies and new means of communication, together with the demographic characteristics of the growing population and numerous changes and widespread catastrophic events on the global level, render planning in education and defining the needed professions harder. Necessary transformations in education are failing to keep pace with all the current changes. This certainly confirms and intensifies the need for lifelong learning. Education should be more adaptable, and the SDGs present a useful framework for that process at all level of education—in primary and secondary schools, universities, and also through lifelong learning process in institutions and communities.

One of the important and possible "recipes" for recovery is to learn, through education, to behave in accordance with the SDG. Among all actions aimed at the SDGs achievement, education seems, in a certain way, to be taking the central place and lying in the very core of sustainability.

It is only with knowledge, awareness, and consequently discipline, that we can achieve sustainability in the widest sense of the word. Therefore, we believe that the SDGs can and should be seen as a framework of education for healthy cities and healthy environment. For example, among health professionals, there is only a small percentage of workforce (less than 3%) engaged in health and health improvement. The overwhelming majority of available human resources are engaged in dealing with consequences and is educated to deal with consequences, not to influence the reduction of disease burden.

How can we foster and boost SDGs in the process of education? How can SDGs serve as a framework for an education directed towards a healthy urban living and pursuing healthier environment? The SDGs should certainly be observed as a framework for curricula in the educational process, as well as in the process of lifelong learning. The knowledge of today's young experts is by no means sufficient and it should be continually refreshed and renewed in the majority of professions (from engineering, through to social-humanistic and medical).

Therefore, on the one hand, the SDGs are to be used in the regular process of education over a wide spectrum of professions (as part of curriculum), and, here, we emphasize their significance for the process of producing health professionals.

On the other hand, lifelong learning process is particularly needed today, and it requires both personal engagement and the engagement of organizations and systems, while the long-term SDGs are to be taken as a framework and motivation for finding ways and resources to achieve the set aims through additional education.

Moreover, it is also important to note that cities (urban areas) have a capacity for autonomy in acting and struggling for the achievement of the SDGs, and that, owing to the community organization and higher flexibility, they can achieve great results provided there is motivation, organization and awareness of the need to actualize the SDGs on a local level.

We are now going to discuss individual Goals, which are never isolated but intertwined in practice. This must be kept in mind and, pursuing a holistic approach, in each goal we must seek a possibility of actualization through education (in various ways and forms), aiming at a sustainable development of cities with a respectful attitude to natural resources (thus enabling the reduction of population health risks to the minimum).

12 The Existing Experiences and Examples from Practice from the Point of View of Medical Professionals

The Republic of Serbia, as a small country (with the population of about 7 million people), located on the European continent but not a European Union Member State, faces many challenges related to demographic indicators opposite from the global trends, the challenges of internal migration (from the countryside to the city), disasters (floods and droughts), a higher health services demand than can be met, and, in addition to this, an underdeveloped industry, economic instability and a high unemployment rate. Climate change affects the population in the same way and to the same extent as in the rest of the continent, while energy requirements are increasingly complex due to great temperature fluctuations. All these symptoms are visible in cities, which, as such, become susceptible to other risks: violence, drug and alcohol abuse, crime and growing poverty.

Health professionals are faced with the consequences, and those who are involved in public health and preventive medicine advocate public health strengthening, as well as measures and actions that will increase long-term resilience of the population (necessarily including education). The total number of preventive-oriented health professionals is insufficient to achieve a qualitative shift, so education of these profiles in the healthcare sector needs to be enhanced.

There are, however, numerous actions and projects on both the local and national level that involve collaboration with other sectors, especially education, in achieving an improvement of urban health. Lifelong learning is present in the field, but it needs to be additionally strengthened.

There are some positive examples of university curricula, which are dedicated to urban health, increasing resilience in cities, promotion and protection of environment. Within doctoral Public Health studies, the Faculties of Medicine offer an opportunity to engage in topics relevant to the contribution to the Sustainable Development Goals. Nevertheless, there is stillroom for introducing additional research topics and professional activities.

In Belgium, initiatives in university curricula related to environmental health and environmental medicine have been identified as a priority of the Belgian National Environment and Health Action plan (NEHAP 2009–2013). It led to a survey of the curricula of all the universities (Van den Hazel et al. 2014). The results showed that Universities and Superior vocational schools are the main providers of educational programmes related to environmental health in Belgium. No curriculum on environmental medicine has been identified at Belgium universities or Superior vocational schools. Courses on the environment and its impacts on human health exist in several curricula, but they mainly consist in introduction and basic knowledge. In the Flemish-speaking universities, one curriculum on Environmental Health is integrated in a Master in Biomedical Sciences delivered by the Medical Faculty of the University of Hasselt. In the French-speaking universities, there is only one specialisation on Environmental Health in the Master in Public Health. That speciality exists since 2007 and there are already about 70 professionals certified, it is organised by the school of Public Health of the Université Libre de Bruxelles. On the other hand, environmental studies are integrated in the Masters of Environmental Sciences in several universities of both Flemish and French-speaking universities.

SDGs are included in the framework of courses in Public Health in the various curricula. We observe the existence of a large number of projects in cities, citizen-science projects and if the professor does not know of those projects, they will not be taken further. Surveys made among the students using post-it to collect what they envision as priorities for actions towards a better environmental health show a limited list of items, air quality, water are among the mostly cited. There is no mention of education and when we speak of health no-one links health to energy or urban planning. Nevertheless, those topics are developed in the curriculum leading to the specialty in Environmental Health of the Master in Public Health of the ULB; where urban health, planning, energy, sustainable development and climate change are at the core. SDGs are used to support an integrative vision in a more global education pattern. Among the students in ULB, various professions are observed from paramedical, physicians, scientists to communication and anthropology. That diversity is used to enlarge the vision and sustains cooperation exercises in a systemic education pathway. Other tools are integrated in education such as the "Health in all policies", DPSIR and DPSEEA conceptual frameworks (Morris et al. 2006; Reis et al. 2015; EEA 2015) leading to enlarge the often too much health-centred approaches used of public health teaching.

13 Who, When and How Should Be Involved in Education on SDGs for Healthier Urban Area and Healthier Environment?

As it has been stated within Goal 4, free, equitable and quality primary and secondary education is the priority. Knowledge is a necessary precondition for sustainable development. Thus, commitment to sustainable development is needed

from primary education through curricula and syllabi, and an inclusive provision of a sufficient corpus of knowledge and skills.

The answer to the question of what professions should be involved in learning about the SDGs is: all—in suitable ways. Reaching the complex SDGs requires knowledge of young experts from various professional backgrounds. An education for sustainable development and sustainable lifestyles, human rights, gender equality, promotion of the culture of peace and non-violence, sustainable development, global citizenship, appreciation of cultural diversity, and enhancement of resilience, is an imperative for the future.

According to Walter Leal and collaborators, "*government and policymakers should support the higher education sector in responding to the student demands for sustainable development to be promoted in their institutions and provide guidance to ensure that learning and teaching resources on employability include the issue of sustainability*" (Leal Filho et al. 2015).

Knowing facts, as well as the reasons for acting upon them, should be a motive for appropriate lifestyles, preservation of personal health through appropriate behaviours, and the preservation and improvement of the environment and infrastructures in cities.

A higher number of the young and adults with relevant skills, including engineering, professional and social skills for the development and preservation of a healthy urban area will, most certainly, be needed in the future. Strengthening human resources in various professions, undoubtedly including the sectors of education and health (both qualitatively and quantitatively), is of utmost importance for sustainable development.

14 Instead of Conclusion

It seems that humankind has somehow "got stuck" in the material world and that we have been relentlessly exploiting the planet, leaving less and less room for non-material humanistic values. This additionally contributes to numerous problems, sustainable development and health included. Production and honing intangible values, however, is of a crucial importance and can contribute to affecting balance. Creating intangible heritage is unique for human beings, and is presented through non-material humanistic values we seek to pass on to the future generations. Education arises as the key for finding the right measure and finding the way to sustain ourselves in the balance between tangible and intangible.

Education as a process is a powerful tool for contribution to urban health, and certainly one of the ways to cultivate intangible values (including art) for the purposes of health, with the construction and preservation of tangible assets and infrastructure in a rational manner, making it accessible and available to future generations.

Education seen in this way is a powerful engine that can drive us to the achievement of Goals 11 (Healthy Cities), 3 (Wellbeing), 13 (Climate Change), and

17 (Partnership). Moreover, education strengthens capacities and enables a higher quality and more efficiency in achieving all the SDGs. And vice versa, the SDGs can and should present a framework for curricula and contribute to literacy, raising awareness, and contribute to excellence in various professions that will enable reaching the Goals. The children who start school today will be finishing their studies at the time when conclusions are to be drawn on the achievement of the Goals set in 2015. We are obligated to them to provide them with enough information, help them to gain the knowledge needed and enable them to acquire sufficient skills for being active participants in a future cycle of the struggle for a healthier planet and urban areas as central places for the life of human population.

This chapter is presenting an analysis from the perspective of professionals and experts in the field of environmental protection and health. This could be extended by involving views of multidisciplinary team of experts which might propose how to link, through networking activities, different actions based on SDG, in order to additionally contribute to population and urban health.

Further constrains are related to administrative procedures for introducing new approach into education system, which are time-consuming and bring the risk that the necessary innovations are introduced in education slower than needed.

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Healthy People Living on a Healthy Planet—The Role of Education of Consciousness for Integration as an Instrument of Health Promotion

Roberto de Almeida and Patrícia Garcia da Silva Carvalho

Abstract Life on this planet depends on the level and quality of integration of the different species that inhabit it. The economic, social and environmental impacts and consequences of the Anthropocene Age result from the mistaken assumption that *Homo economicus'* decisions are always rational. In every human society, the bidirectional interaction between social determinants and the self-determination of peoples' lifestyles influences their behaviors according to a set of attitudes, beliefs, values, and consumption patterns. These behaviors, in turn, generate a specific quality of social life and degree of equity in health. Engagement with the 2030 agenda of sustainable development goals can be achieved through lifelong learning movements that foster the re-education of values and paradigms via training from social actors, such as environmental educators, health promoters, and cultural mobilizers, grounded on the ethics of caring. The much-needed environmental education provides a propitious field for innovations in human development based on a new approach to the education of consciousness and health promotion. Through the articulation of human needs related to multidimensional aspects of health, societal living, the natural environment, and sustainable development, the approach of Integrative Health aims to promote healthy people living on a healthy planet. Integrative Health represents a harmonizing approach that avoids paralyzing bioethical conflicts in the polysemic field of determinants of health. Experiences of socio-environmental responsibility, such as that of Itaipu Binational, which made viable the Cultivating Good Water program, an internationally recognized program that received the Best Water Management Practices award at the UN's 2015 Water for Life Awards, evidence the possibility of this transformation in different territories

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and cultures. The expected result from Integrative Health Promotion based on education of consciousness is an increase in the social capital of communities and a greater commitment to the values and principles of a new human rationale, that of *Homo sustentabilis*. The consciousness education of integrative health principles facilitates the learning to care for oneself, others, and the environment.

Keywords Consciousness · Environmental education · Health promotion Integrative health · Sustainable development

1 The Future of Humanity

> The greatest obstacle to living is expectancy, which hangs upon tomorrow and loses today.
>
> Seneca

At the beginning of the 21st century, concerns about the future are increasingly intense due to the pattern of exponential growth of global change (Gore 2013) and Anthropocene Age or the humankind's growing influence on the environment (Crutzen 2002). According to Harari (2016), *Homo sapiens* was able to change in 70,000 years the global ecosystem with an impact comparable to that promoted by asteroids, tectonic plates movement and climatic changes such as the ice age.

Several authors explore expectations about the future of humanity and offer suggestions to rethink our actions in the present, for example: The Future: Six Drivers of Global Change (Al Gore), Homo Deus: A Brief History of Tomorrow (Yuval Noah Harari); Seven Complex Lessons in Education for the Future (Edgar Morin); The Triple Focus: A New Approach to Education (Daniel Goleman, Peter Senge); Theory U: Leading the Future as it Emerges (Otto Scharmer); Political Ecology (Gert Schinke); among others.

Technological and scientific advances continuously generate new forms of economic, social, territorial and cultural organization, amplifying the potentialities of a human being's life within the physical limits of planet Earth. This conflict between new possibilities available to an increasing number of human beings, new patterns of consumption and limited natural resources, focus tension on and are concern regarding sustainability: ensuring a balance between economic, social and environmental factors for current and future generations.

The notion of future economic growth is infinite is based on various beliefs and misconceptions. Among them is the belief that human behavior and decisions are always rational, consistent with self-interest and in accordance with the model of *Homo economicus*.

Coleman (1988) accepts the traditional principle of rational or purposive action of individuals but also consider that appropriate social context promotes the development of social organization. The result is the conception of social capital as a new resource for action.

Henrich et al. (2001) clarify that recent studies evidence the failure of this model of *Homo economicus*. The Nobel Prize winner Herbert Simon, cited by Michel-Kerjan and Slovic (2010) introduced the notion of "bounded rationality, according to which cognitive limitations force people to construct simple models of how the world functions in dealing with everyday situations" (p. 3).

This simplistic model of the world reflects a partial perception of a complex reality under the level of awareness and personal education. A limited mentality raises one of the most critical aspects of the philosophy of mind and one of the most challenging scientific themes: consciousness.

According to Chalmers (1996), "consciousness is the biggest mystery. It may be the largest outstanding obstacle in our quest for a scientific understanding of the universe." (Introduction, para. 1). Considering this information, we understand that consciousness, as a research object, must be taken seriously in investigations and current and future public policies.

Each human being is a consciousness, a polysemous word that can both represent the subjective experience of the person possessing lucidity of their experience through cerebral activities, and refer to the essential ontological nature of living beings (Essential Self).

Consciousness, or the self-conscious action of people, can be understood as the creative organizing principle of social life. According to Fuchs (2003), in the re-creative process, individuals who are part of a social system can permanently change their environment, allowing the social system to change, maintain, adapt or reproduce itself. The fundamental point of this process is the ability of the human beings to be self-conscious or to monitor their actions and experiences reflexively.

In this context, each consciousness learns and comprehends through the interaction of perceptions, intimate experiences and relations to the here-and-now. Thus, education of human consciousness is one key to the sustainable future of humanity and the basis for the proposal of intervention in the promotion of integrative health based on the quality of social life. According to Braun (1983) consciousness education has a role in developing global perspective. Goleman and Senge (2016) also understand that an innovative approach to education that promotes the triple focus or the self-awareness (inner-focus), empathy (other-focus) and systemic thinking (outer-focus) is necessary to meet the demands of the new generations and the social and ecological challenges of the contemporary world.

Systemic thinking, self-experimentation, ethics of caring, and salutogenesis are hallmarks of the proposal of consciousness education, which are applied in the context of ecology and ecopedagogy, providing space and opportunities for a methodological construction of the conception of Integrative Health.

The future of humankind needs less preoccupation and more innovations of our minds in our current approach to human lifestyles, social connections, and ecosystemic interdependencies.

2 Humanity's Present Moment

The current structure of our brains is not very different from that of our ancestors from about 200,000 years ago, but we are now subject to an information process unprecedented in its quantity and quality.

According to Lee et al. (2016), the perceived tendency is that technological mediation of information and communications generates increased stress and fatigue. Misra et al. (2016) observe worsened empathy in the presence of cell phones. Boff (2008) perceives carelessness as a sign of our times.

The increasingly observed effects are people who are distracted, have sped up rhythms of behavior, have a poor quality of life in the here-and-now, and lack presential strength.

The strength of a person's presence reflects their prioritization of interaction with humans instead of machines, and their level of lucidity in the here-and-now (Vieira 1994, p. 276). The lack of presential strength of human consciousness generates alienation and when considered collectively causes an impoverishment of social capital resulting in unprecedented social and ecological challenges.

The notion of presential strength of human consciousness correlates with mindfulness (Williams and Penman 2015) and presencing (Scharmer 2016).

Due to a lack of attention, or mindlessness, our behaviors remain on autopilot, in a kind of "existential robotization" (Vieira 1994, p.57), and life numbness (Hayes et al. 2012). This sort of alienation also translates into the absence of meaning, incoherence with personal values and lower relevance of attitudes and ways of being in the world, thus compromising the quality of an individual's social life.

According to Langer and Moldoveanu (2000), the problem of mindlessness has become a social issue. Complex situations of prejudice, stereotyping, and oscillation between anxiety and boredom are related to mindlessness behaviors that lead to human errors. This social impact of mindlessness causes harm to the social capital held by communities.

Mindlessness is a state of mind characterized by the entrapment of the mind in old categories and discriminations, through automatic behavior, which prevents interaction with relevant new information and results in action guided by a single perspective. (Langer 2016, Introduction, para. 8).

Humanity's present moment is paradoxically characterized by the declining quality of being present in the here-and-now. Information and communication technologies generate information overload, distractions, worries, and make people absent-minded, sometimes being in the here but not the now, or vice versa. People without presential strength are rarely available for face-to-face dialogue, now progressively considered unpleasant. The tendency is to increase communication problems and conflicts due to a lack of intercomprehension.

According to Hanlon (1971), p. 5, "The problems that affect human being are basically reducible to three: (1) the problem of understanding and living with themselves; (2) the problem of understanding and living with others or with

Society, and (3) the problem of understanding and living with their environment or ecosystem."

The lack of presential strength, mindlessness, and the poor quality of life in the here-and-now appears in every country and currently generates several problems in individuals and collectives.

According to Scharmer (2016), this pattern of absence represents a state of disconnection from others and oneself, with destructive effects for all. Disconnection results in three major divides: "the ecological divide—that is, the disconnect between self and nature; the social divide—that is, the disconnect between self and other; and, the spiritual divide—that is, the disconnect between self and self." (Scharmer 2016, Introduction, Sect. 1, para. 1).

Today, these patterns of cleavage, disconnection, and misunderstanding affect humanity's conviviality, generate systemic interferences and maintain results that no one wants.

There is a tendency towards pathological sustainability or maintenance of the status quo of social positions, economic traditions, institutional bureaucracies, and the political *modus operandi*.

Based on Pierre Bourdieu's contributions, Setton (2006) developed the concept of *habitus* as an instrument for thinking about the relationship, mediation between external social conditionings, and the subjectivity of subjects. "*Habitus* is not destiny. … [but] a cultural matrix that predisposes individuals to take some decisions." (Setton 2006, p. 61).

The tendency of educational methodologies and psychological therapies to value mindfulness reflects the urgent need for education and re-education aimed at strengthening consciential attributes.

Attention, lucidity, and discernment are qualities of the consciousness that should be respected and valued in each human being, given that interventions to expand them dignify healthy living, along with educational and interassistantial acts. Interventions to manipulate and diminish such consciential attributes represent unethical acts.

Different patterns of consciential attributes influence the quality of health behaviors and produce better or worse health of the people and planet.

The Institute for Metrics and Evaluation [IHME] (2016) analyzes the global burden of disease by dividing it into three broad groups: (1) non-communicable chronic conditions (cardiovascular disease, cancer, diabetes, etc.); (2) communicable conditions (infections, nutritional disorders and maternal/neonatal problems); and (3) Trauma injuries.

Another important observation in sustainable development is the epidemiological transition, in which "countries that were previously referred to as developing countries have, in recent decades, begun to experience health problems increasingly similar to those of countries referred to as developed." (IHME 2016, p. 13)

According to Beaglehole et al. (2008), chronic diseases accounted for 60% of global mortality in 2005. Paradoxically, economic development also encourages an unhealthful behavioral and the increasing prevalence of chronic conditions due to factors that include urbanization, population aging, changes in diets and lifestyle

patterns (Yach et al. 2004, p. 2620). Bettcher et al. (2000) warn on linkages between global trade and health and the need for "healthy trade" planned to improve the status of health.

It is important to reflect on the interrelationship between the advance of these chronic conditions and the patterns of social organization and people's lifestyles. The *habitus* together with the low quality of social life created by individuals in the current process of urbanization may stimulate lifestyles where consciential attributes are characterized by mindlessness, a low level of lucidity, and poor discernment, which generates behaviors such as carelessness. Indicators of humanity's and the planet's poor health may reflect a lack of self-care and a lack of care for others and the environment, whether a room, house, neighborhood, city, and so on.

Integrative health reflects the synergistic interaction of conscious lifestyle with the living environment (physical, biological, ecological, social, cultural, economic and political) necessary to sustainable health promotion.

3 Integrative Health

Health is one of the most agreed upon human values. Any conception of health is considered a universal basic need to guarantee human dignity through the promotion, protection, or recuperation of structural, functional and multidimensional integrity suitable for a good quality of life. Moreover, it is also considered a fundamental human right.

According to Chapman (2015), although commitment to human dignity is a widely shared value, there is still a lack of clearness in the foundations of the right to health.

In his book Health Justice, Venkatapuram (2013) extends to health the capabilities approach of Amartya Sen and Martha Nussbaum. He argues that every human being has a "moral right to the capability to be healthy as fundamental value" (Venkatapuram 2013, Introduction, Sect. 4, para. 1).

According to Venkatapuran (2013) "Health is a meta-capability, an overarching capability to achieve or exercise a cluster of inter-related and basic capabilities to be and do things. This conception rejects the notion of health as the absence of disease and advocates a positive conception of health…" (Conclusion, para. 2). In this way being healthy, means have more freedom to enjoy a better and longer life.

This approach to capabilities and meta-capabilities is fundamental to the concept of integrative health developed in this chapter. It reinforces the need for health promotion based on the education of salutogenic competencies, character habits, and systemic thinking, so individuals and communities know how to improve their lifestyle and promote the social transformations necessary for the quality of the environment in which they live.

In the context of health determinants, inequality is a global and increasingly urban challenge. According to Marmot (2015), differences in health go beyond rich

and poor, and the relative "social disadvantage" in each society is the differentiating factor in people's levels of health and longevity.

Marmot (2015) reinforces the role of empowerment as a strategy to change situations of relative social disadvantage. Individual and social empowerment creating conditions for people to have more control over their lives, to have the power to live as they wish.

The fallacy that only money allows better living conditions needs to be decisively overcome. Money or income is a prerequisite, but it is not enough.

Integrative health aims to raise consciousness, educate and re-educate people to empower the processes of changing lifestyles, transforming groups and improving community cooperation to create a culture of health where dignified conditions of life, positive social and environmental results and profound meanings of life are possible. Integrative health develops a harmonizing approach among health determinants by promoting individual and social responsibility for the synergy between the human lifestyle, and the socio-environmental factors.

The concept of health generates much debate in various lines of knowledge. In this proposal, we will use integrative health to represent a systemic approach that permits progressive accomplishment of the integration of different aspects or dimensions of health such as bio-psycho-socio-ecological-spiritual well-being. The inclusion of the ecological dimension of well-being is a critical focus of this chapter.

The proposal of integrative health represents both individual and collective active mental states that sustain and ensure the structural and functional integrity of people's lives and the planetary ecosystem. Integrative health signifies healthy people living in a healthy planetary ecosystem. Also, integrative health means healthy living conditions for the current and future generations.

Many ills and diseases in our society are due to limiting and reductionist paradigms, which generate insoluble dichotomies: mind /body; humanity /nature; anthropocentrism /non-anthropocentrism; intrinsic value /instrumental value; economic /ethical; theory /practice; among others.

One of the major themes in the health debate is related to determinants of health. According to Hancock (1986), the Lalonde Report published in 1974 recognized that health care services were not the most important determinant of health. The report proposed four "health fields" (Hancock 1986, p. 93): human biology, access to health care organization, living environment, and lifestyle. Besides controversies, this model has been influential in expanding the public understanding that health is determined by more factors than health care.

One of the ideological challenges in the health promotion debate lies in the emphasis placed on determinants proximal to the person (genetic and lifestyle) or distal determinants (living conditions, social, political and economic factors). Socialist ideologies see a greater impact from distal determinants and people's health is mainly considered a consequence of iniquity. Liberal ideologies value the impact of proximal determinants more, especially lifestyle choices, usually criticized as the "*victim-blaming approach*" (Hancock 1986, p. 95).

Both distal and proximal determinants coexist in an integrated manner. The attempt to oppose one to another is an unproductive dichotomy of reductionist paradigm. This debate is paralyzing and sometimes makes it unclear to orient health providers, health system managers, decision and policy makers.

Integrative health predicts that both living conditions (distal determinants—environment, cultural and socioeconomic factors) and lifestyles (proximal determinants—health behaviors) systemically interact to create pathogenic or salutogenic epigenetic impacts and health outcomes of populations.

The integrative health approach recognizes that the main idea intrinsic to the concept of health is integration. The idea of integration expresses two fundamental aspects of systemic nature: differentiation and connection of the elements that form a whole.

The Cartesian paradigm, with its reductionist method, was necessary for the first moments of scientific development and was characterized by a focus on the analysis of the differentiated elements. Moreover, now, due to the exhaustion of this paradigm, exist an increasing demand to focus on connections between the elements.

Systems' biology (Carvunis et al. 2012) point to the notion of that "the system" being the fifth fundamental element in the constitution of what we call life, in addition to these four: genes, macromolecules, cells, and evolution. The application of system pathobiology to medicine will revolutionize the healthcare (Loscalzo and Barabasi 2011).

There are important ideas to consider in operationalizing the promotion of integrative health: (1) health assets (Morgan and Ziglio 2007) (Morgan et al. 2010); (2) positive health (Ryff et al. 2004); (3) culture of health (Plough 2015); (4) ecosystem approach to health (Forget and Lebel 2001); (5) quality of life as medicine (Ventegodt et al. 2011); (6) health interventions via network targeting (Kim et al. 2015); (7) network phenomena (Christakis and Fowler 2007); (8) network medicine (Barabási et al. 2011); (9) epigenetics in health disparities (Shonkoff et al. 2009); (10) salutogenesis (Lindström and Eriksson 2006) (Mittelmark et al. 2017).

A viable, practical summary would be people living in active community networks forming social capital and through salutogenic competencies and commitment to changes in lifestyles and life conditions generating pragmatical consequences in indicators of the quality of social life capable of transforming people and communities network into pro-health resources and no longer just consumers of health services.

There is a link between better health and social capital or "the features of the social organization, such as the density of civic associations, levels of interpersonal trust, and norms of reciprocity, that facilitate collective action" (as cited in Hurtado et al. 2011, p. 584)

Learning about health determinants and how to promote a salutogenic integration of the many principles of health based on scientific evidence, health theories, and ethical principles is an opportunity for health promotion and education projects within a lifelong education approach.

According to Delors (2004), the division of a lifetime into an age to study, an age to work, and an age to enjoy retirement, is no longer adequate. The result has been aging with a poor quality of life, due to chronic diseases related to a pathogenic lifestyle, poor connections, without self-care and in neglected, degraded living environments.

Individuals have the right to learn to be healthy and to have the opportunity to develop competencies on themes important for integrative health throughout their life, making them able to act as an exemplary multiplier of salutogenic principles. Beyond this, people learn more when they engage in activities meaningful to their lives and learn by doing together with their peers. Then lifelong education of integrative health principles improves the quality of social capital. Also, this integrative approach of lifelong education can be an antidote to the downside of social capital observed by Portes (2014).

At every stage of life, certain human needs and values influence one's lifestyle and can result in different consumption patterns that directly affect the production of goods and services and impact the natural resources.

The style of consumption defines the production of goods and services, which through marketing, in turn, influences lifestyles and consumption. This connection between lifestyles and consumption patterns is fundamental to shape society's economic model and, in this approach, is a critical point that intervenes in the health of the planet.

Mental models with limiting irrational beliefs, incapable of systemic perception and rational reflection, generate lifestyles (habits, choices) and consumerism based on low levels of awareness, attention, lucidity, and discernment, which has deleterious effects both on the health of the people and the planet's ecosystems. Heffernan (2011) draws attention to the paradox of willful blindness, which makes people feel safer even when putting themselves in greater danger.

Unconscious consumption reflects a lifestyle that is inattentive and careless for oneself, others, and the planet. It is from this central point that the need for lifelong learning, education, and re-education in healthy and sustainable cities arises to focus on developing and enhancing awareness for integration of both people's and planet's health as a strategy for sustainable human development.

In the urban context, is necessary to innovate the design of public spaces for lifelong learning. To promote integrative health principles with new methodologies of active learning is fundamental salutogenic architecture and adequate ambiance. Examples of activities are group dynamics, clarification of values, experiments about the determinants of health, ethical principles applied to health, restorative circles, the elaboration of a code of personal integrative health, and code of group integrative health.

4 Experience with Integrative Health Education in a Watershed

The experience in integrative health education realized in the Cultivando Água Boa (CAB)—Cultivating Good Water Program, a Land and Water Management program created by Itaipu Binational and recognized by the UN, is based on critical and participatory environmental education.

Itaipu Binational is one of the companies in the Brazilian electricity sector and in 2003 it reviewed its institutional mission and inserted socio-environmental responsibility and sustainability as objectives alongside the generation and distribution of electric energy. This change in the mission led the company to develop the Cultivating Good Water Program in the region encompassing the Bacia do Paraná 3 (BP3)—Paraná watershed 3. This region includes 29 municipalities on the Brazilian side of Itaipu Binational, and that represents a total area of 8000 km^2 and over 1 million inhabitants.

The CAB is composed of 20 programs and 65 actions including management and monitoring of water resources, fish farming, medicinal plants, organic agriculture, conservation and recovery of roads, cultural heritage, soil management and preservation, sustainability of indigenous communities, restoration of riparian forests, biodiversity corridors, conservation of wildlife, among others.

The environmental education program (EEP) acts as the guiding and articulating axis for the 20 programs aiming at the integration of knowledge, dissemination of values associated with the ethics of care, and the culture of peace. To this end, the EEP is configured based on the National Environmental Education Policy (Brazil), which is structured through social participation and mobilization, the gathering of knowledge, a systemic vision, and critical thinking seeking to inform citizens and empower individuals and collectives.

The operation in BP3's 29 municipalities occurs through the Training of Environmental Educators (TEE) and organization of local educational collectives that integrate social actors from diverse sectors of society who develop participatory and socio-environmental projects in each municipality.

Among the various programs, the authors of this chapter had a role in the Environmental Education Program, applying the approach of integrative health in two actions: (1) the project to train environmental educators through an ecopedagogical approach that includes the notion of integrative health connecting the issues of personal health and the ecosystem's health. (2) the project of school-based ecopedagogy in which integrative health aimed to promote healthy and sustainable schools by combining environmental education with the training and re-education of teachers regarding changes in lifestyle based on integrating salutogenic principles as a strategy to achieve a better quality of life.

CAB is a movement for sustainability that has water as an interconnection factor. These dynamics occurs through the interaction of different groups and social sectors, through partnerships, through the capillarity of educational projects and actions, promoting changes in the territory from the intimate changes of social

actors. Continuing environmental education, based on educational interventions in the region, encourages co-responsibility and the development of competencies of social actors, from knowledge translation and the meeting of wisdom, strengthening the social fabric.

Over the 13 years of implementation, some benefits generated in the region can be observed, such as (1) Minimization of environmental liabilities. (2) The assumption by Itaipu Binacional of the role of catalyst element of the regional development in counterpart to the past socio-environmental impacts associated with the implantation of the hydroelectric plant. (3) Conservation of water as the raw material for power generation regarding quality and quantity. (4) The improvements made in the operational management of the lake. Sedimentological studies have shown results of better soil conservation in the surrounding and affluent rivers. (5) Improving the image of the company that is recognized as an economic and social driver. (6) Development of technological innovations and knowledge through the research of the PTI (Itaipu Technological Park) that directly affect the operation of the company. (7) Reconstruction of social relations with the resolution and cessation of new judicial conflicts (farmers, fishers). (8) Promotion of International visibility that has direct repercussions on the value of the company and its assets. (9) Development of capacities for social mobilization to address environmental problems in the various sectors of society. (10) Construction of a network of partners with political abilities and decision-making. As well as (11) Change environmental conditions in BP3 (soil conservation, water conservation, recovery of riparian forests, springs, adoption of sustainable practices, solid waste management, Regional culture valorization, social empowerment of vulnerable groups, catalysis of regional social capital).

However, apart from all the favorable aspects mentioned above, it can also be observed that along the process there were gaps or managerial failures that jeopardize the results of the program at the local and regional level. Such as (1) Unequal investment in environmental education actions between the territory of BP3 and the corporate (internal) environment. The environmental education beyond the company has advanced more than the one of the internal environment generating mismatches. (2) Fragility in tying the results of all programs limiting the historical reconstitution of the process. (3) Lack of internal preparation for understanding the dimension of the CAB, which causes a delay in the decisions and difficulties in the implementation of some actions with the compromise of the interpersonal relationships. (4) Failure in the management structures of the program, the management committee, without internal preparation of program managers and social actors that make up the board. (5) The dependence of the local players on the financial resources allocated by Itaipu in most of the actions carried out in the territory. And (6) The susceptibility of the CAB to the political changes at the federal level that interfere directly in the management of Itaipu Binacional.

The convergence between Integrative Health and the CAB was mainly due to the theme of water, an essential element for life and health, and that the condition of supply and basic sanitation reflects the living and health conditions of the population. Also, integrative health invites the individual to think about their lifestyle

and their relationship with the body and the environment, a provocation also proposed by the program when thinking about habits and personal and collective attitudes towards the environment of the house, the neighborhood, the city, the state, the planet.

Environmental educators are invited to exercise social prominence and to develop autonomy in health, observing the multiplicity of aspects associated with the concept of integrative health.

The focus on the integrative health of the teacher is justified because according to Delors (2004), "around 70% of world's teachers live in difficult circumstances incompatible with their vocation and the role they should play in society" (p. 181).

The teacher in the municipalities of BP3 is recognized as an important social actor in internally articulating the environment of the school (students, parents, administrative assistants, pedagogical direction, and coordination). Moreover, beyond the school's walls, teachers take part in the Municipalities' education, health, and environment councils, besides developing projects that integrate the school with the neighborhood community and the municipality.

More than 50% of environmental educators in BP3 formed over the last ten years are teachers in the public education system. They are people sensitive to and trained in the ambit of local, regional and global socio-environmental issues.

The notion of integrative health was fundamental in both the environmental education projects for adults. People, in general, lack an approach that respects them as a consciousness able to be autonomous and with a creative potential to transform the meaning of their lives, and thus, transform living spaces to generate a higher quality of life.

According to the consciousness theory proposed by Tononi (2004), one founded on information integration, consciousness is central to the creation of knowledge from information perceived. Also, according to Tononi (2004) consciousness corresponds to the capacity of a system to integrate information.

Several natural processes express a combination of differentiation and connection of parts forming an integrated whole in living systems like cells and multicellular organisms, and in social groups.

The notion of the system reflects differentiated elements connected amongst themselves to form a whole. "A system is any group of interactive, interrelated or interdependent parts that form a complex and unified whole that has a specific purpose." (Kim 1999, p. 2).

Each human being is a consciousness that integrates information and is a system with singular purpose formed by a complex interaction of many parts. When humans organize themselves, they form social systems, and together with all other living beings constitute the planetary ecosystem.

It turns out that awareness regarding integration is an essential epistemological foundation for organizing the lifelong education and promoting both the health of people and the health of planetary ecosystems.

According to Capra (2006), as the 21st-century advances the challenge of building and maintaining sustainable communities becomes more important. That is the main

reason why it is necessary to understand and experience systemic thinking and the notion of systems (familial, educational, urban, geographic, ecological and political).

The conception of ecological literacy inspired by the theories of Fritjof Capra and other leaders of the Center for Ecoliteracy, in Berkeley, California, goes beyond environmental education as a classroom subject. This approach is based on the assumption that education must take place beyond classrooms and be experienced through projects such as school gardens and the recuperation of basins.

Ecological literacy combines theory and practice by developing the experience and understanding of systemic thinking and ecology.

It is important to mention that Fritjof Capra was one of the thinkers who composed the epistemological matrix of the CAB program, and that the educational collectives start with the proposal of ecological literacy through socio-environmental projects developed in communities.

Another important pillar of the CAB program was the ethics of caring proposed by Boff (1999) that shows us the process of care in its various spheres, taking care of planet Earth within a sustainable society. This approach of taking care of the body and the spirit instigates the appropriation of values and attitudes for life on the planet.

The urban environment is an essential space to develop the perspective of integrative health presented here, integrative education of consciousness and life-long learning, given the, already developed, concepts of sustainable cities and healthy cities.

5 Education of Consciousness for Integration

When analyzing the global complexity of current human life with its interconnected political, economic, scientific, technological and social systems, a feeling of powerlessness and inability to change is to be expected when considering of and proposing individual and local specific solutions.

Scientific and technological innovation has already shown its transformative power by accelerating human history over the last 500 years through its focus on reductionism.

Now the moment is to understand the possibilities of transformation of humanity through the creative power present in each human consciousness, by focusing on an integrative and systemic vision.

Education and re-education of consciousness regarding integration is a strategy to implement the promotion of integrative health or bio-psycho-socio-ecological-spiritual well-being, which facilitates a quality of social life for healthy people to live on a healthy planet.

The traditional education of consciousness is a values-based amateur family education. Usually, this informal consciousness education is subject to high degree of variability according to the relative social disadvantage of the families.

Sustainable cities and schools, healthy cities and schools and lifelong learning initiatives need to give particular attention to the quality of consciousness education and not just work on contents.

The sustainable present-future of humanity on this planet progressively depends on the greater ability of individual consciousnesses to cooperate harmoniously among themselves by promoting systemic integration between different scientific fields and sectors of life.

Sustainability is a complex issue that needs a new paradigm of action research to guide the transformational experiences of consciousnesses, communities, institutions, nations and ultimately the planetary ecosystem. An integrative paradigm for sustainable development should be the principal focus of academy efforts. According to the review of Wiek et al. (2011), there are key competencies in sustainability that should be a reference framework for an academic program. According to Barnosky et al. (2016) to build a sustainable world, academics need to tear down the *ivory tower*.

The following seven learning priorities to educate and re-educate consciousness for cultivating integration and promote integrative health represent a contribution to this new knowledge translation endeavor and, a proposal of an initial curriculum of conscious sustainability to be applied to lifelong learning initiatives.

5.1 Volitional Learning

Learning to have volition or free will means to integrate the capacities to dominate the willpower (Baumeister and Tierney 2012), have grit or strength of character (Duckworth et al. 2007), cultivate self-determination (Deci and Ryan 2012), promote autonomy and self-regulation (Ryan and Deci 2006) and have control over health (Wallston 1992).

Volition represents a major challenge today because the prevalent urban lifestyles present the pathogenic habits of carelessness, existential robotization, mindlessness and escapism from stressors that make people feel exhausted and without sufficient will to make changes or conscious choices. It seems that people are prisoners of themselves, their way of thinking, feeling and being. Thus, learning to have and exercise willpower reflects a method of self-liberation from the process of mental slavery, alienation and disempowerment created by the current *habitus*.

The strength of the unity of people in a society depends on the perception of and confidence in individual and group volitional potential. Healthy and good quality social capital rely on the collective strength of volition resulting from the union of people around ideas and actions constructive for society and connectedness to the ethics of caring.

Therefore, promoting integrative health is based on educating to empower and to develop capabilities of self-determination to create a more salutogenic lifestyle and ecosystemic balance. That means access to better knowledge on health and experience of better conscious choices that result in a qualification of personal habits and

social network connections. In this sense, volition qualified for the common interest and a sense of belonging overcomes the process of inducing the masses to follow the common capitalist vision that promotes hedonistic individualism.

Conscious capitalism, proposed by Mackey and Sisodia (2014), is a new approach to capitalism that shows greater respect for the best interests of conscious customer now considered important stakeholders in a conscious business.

The rising quality of consciousnesses helps us become more caring, systemic, and long-term committed in our thinking and actions. The self-control and will-power allow a better control of impulses to act now at present with more responsibility and respect for the future. Healthy self-regulated consciousnesses are more harmoniously integrated with others and with the whole planetary ecosystem.

5.2 Intentional Learning

To learn to qualify intentionality means to distinguish the first and second intentions, to understand that there are intentional conflicts between instincts, desires, and rationalizations. According to Malle and Knobe (2001), there are distinctions between desire (wish, hope, want) and intention (decide, plan, intend) that are important in social cognition.

According to Brazilian educator Cortella (2016), ethics reflects the handling of internal conflicts where: "Not everything I want, I can have. Not everything I can have, I should. Not everything I should, I want".

In this sense, integrative health includes a component of moral well-being in which the level of personal coherence with personal values and principles reflects the intentional guidance of actions in daily life. The more qualified the intentionality, the greater the self-esteem, and better the moral well-being. Moral health demands a non-religious morality based on new perspectives of transcendence and ethical values.

In the project of integrative health promotion, we have adopted the ethics of care and a culture of peace to qualify intentionality. The ethics of care involves the cultivation of self-care, hetero-care of others and communities, and holo-care or caring for planetary ecosystems. This view of care extrapolates the ego and transcends, once again, to the common good.

One of the practical tools used to develop moral health and qualify intentionality is the Code of Personal Integrative Health (CPIH). With this tool people freely choose personal goals related to lifestyle and living conditions changes and write specific clauses that orient actions to change habits or circumstances.

Personal commitment to one's values is the intrinsic motivation that promotes the transformational results of a CPIH. This level of self-commitment qualifies the intentionality, increases control over health, and brings awareness to the limits of individual and collective change. There is additionally the tool, a code of group integrative health (CGIH), that guides a family's or collective's commitments in improving habits or living conditions.

According to Tannahill (2008), beyond scientific evidence and theories, it is essential ethical principles for health improvement. The 21st century will need more studies on intention to cope with the sustainability challenges.

Learning the lifelong qualification of intentionality through coherence with ethical values is one pillar of consciousness education that supports the culture of integrative health and sustainability.

5.3 Self-Organizational Learning

Learning to be self-organized means having self-discipline (Duckworth and Seligman 2005), acting with self-efficacy (Gist 1987) (Lawrance and Mcleroy 1986), cultivating healthy habits and useful routines (Vieira 2010), developing a general resilience (Franklin 2013) and promoting a systematic change of habits (Prochaska et al. 1994).

According to Fuchs (2003), the impact of the theory of self-organization promoted a change of scientific paradigm: from the Newtonian paradigm to the complexity paradigm.

The survey made by Duhigg (2013) clarify the need and importance of understanding how habits work and how to change them. The level of people's organization is related to the quality of their habits.

Self-organized behavior provides greater balance and the possibility of expanded learning. In this way, understanding one's physical, emotional, energetic and mental functioning leads to increased self-organization. This approach of self-organizational health reflects the organization of all bodily organs and systems, and also the social life. A disease is disorganization of the structure and functioning of living organisms and collectives.

Mental disorganization or a mental disorder is a growing problem among humankind, as expressed by rates of depression (World Health Organization 2016) and suicide (Bertolote and Fleischmann 2015). Mental health reflects order, organization, and balance in the integration of several dimensions or aspects in the lives of individuals and communities.

In the approaches of integrative health promotion, people begin to value organized behavior, healthy eating habits, regular exercise, sleep hygiene, bedtime routine, mindfulness and stress management as keystone habits for the quality of daily life. The first clauses of integrative health codes, usually reflect the need to change and organize these lifestyle components.

Consciousness education aimed at promoting sustainable integrative health considers self-organization as the necessary ethical medium between volitional initiatives and intentional goals.

5.4 Maxifraternal Learning

Learning to be maxifraternal means to love with maximal fraternalism or fraternity. This also means learning the connection role in integrative approach: (1) live together (Delors 1998); (2) cultivate micro-moments of positivity resonance (Fredrickson 2013); (3) develop effective altruism (MacAskill 2015); (4) know how to be a giver (Grant 2013); (5) develop volunteer activities (Lum and Lightfoot 2005); (6) promote positive peace (Grewal 2003); develop transaffectivity (Vieira 2014).

The more you experience love 2.0, "the more you open up and grow, becoming wiser and more attuned, more resilient and effective, happier and healthier. …better able to see, feel and appreciate the deep interconnections that inexplicably tie you to others". (Fredrickson 2013, Chap. 1, para. (5). It is about upgrading the notion of conventional love.

According to Vieira (1994), maxifraternity is a more evolved interconsciential, universalistic condition based on pure fraternity and is the inevitable goal of everyone. The notion of maxifraternity represents the maximum of fraternal love we can have for others, which can generate maximum understanding and forgiveness and thus enable peaceful coexistence.

The concept of maxifraternal bonding or interpersonal connection promotes health in relationships and the culture of peace that is so important in sustainable development as in the qualification of social capital. Learning to break out of egocentrism or self-liberation from atavistic selfishness is an important facet of relational and emotional health. Being involved in volunteering, giving free time to systemic causes, and people in need represents mental, emotional and existential health.

In the promotion of integrative health, it is common to encounter profound professional dissatisfaction and numerous examples of people who volunteer and give their time to help other people or living beings and find deep meaning in their lives by being coherent with their values.

Maxifraternal love is the connection that enables the differentiations of human and nonhuman elements to form an integrated whole in the planetary ecosystem. Consciousness education activates this connective potential by transforming individualities into communities with high social capital that promotes quality of systemic life.

5.5 Intellectual Learning

Learning to develop the intellectuality in an integrative way means learning to learn (Delors 1998), develop conscious regulation of learning or metacognition (Koriat 2007), develop systemic thinking (Cabrera et al. 2008), understand complexity (Morin 2002), develop an extended worldview of scientific thought beyond

materialistic science (Vieira 1994), understand the psychology of worldviews (Koltko-Rivera 2004), and cultivate transdisciplinarity (Santos 2008).

Integrative health promotes the notion of intellectual health in which the limited vision of ultra-specialists represents a cognitive pathology, a kind of hemiplegic specialism that cuts the learning of the systemic and complex vision necessary for the construction of salutogenic and sustainable living conditions. In contrast, the promotion of integrative health also seeks to clarify the harm of a culture of superficiality caused by the reckless access to information on the Internet (Carr 2011).

Human consciousnesses educated or re-educated in this integrative approach have an intellectuality adequate to the best management of data, information, knowledge, skills, and wisdom necessary for promoting integrative health and sustainable development.

5.6 *Communicational Learning*

Learning to communicate better means learning to share knowledge about oneself and the world, communicating in a non-violent way (Rosenberg 2003), mastering communication skills according Kuntze et al. (2016), being assertive, expressing and hearing universal human needs, and promoting the clarification task (Vieira 1994), which means exposing ideas to others instead of impose them on others.

Interpersonal relationships can be better if high-quality communication exists, communication that expresses needs and values that promote intercomprehension and a high quality emotional and social life.

The integrative health approach applies the circle methodology to promote a healthy communication. "The Circle is a simple structured process of communication that helps participants reconnect with a joyous appreciation of themselves and others." (Boyes-Watson and Pranis 2015, part 1, Introduction, para. 2).

A community expresses the quality of its social capital through its level of connectivity, shared values, and the mutual help apparent in satisfying universal human needs. Simultaneously assuming the role of an educator, and in other moments, the role of an apprentice promotes the empathy essential to qualify communication and individual expression within the collective.

The construction of consensuses to achieve sustainable development goals will occur through many conversations, debates, and dialogues whose quality depends on the communicational health of the social actors.

5.7 *Parapsychic Learning*

Learning to become parapsychic means cultivate the wisdom to be more open-minded toward intuitions, it means transcending the brain, the ordinary mind,

and the psyche by understanding subtle aspects of complex multidimensional reality.

Understand parapsychic phenomena or paraphenomena relates to assuming the concepts of self-transcendence and peak experiences developed in Maslow's theory explained by Koltko-Rivera (2006).

Schlosser (2017) advocates expanding consciousness in a spiritual and non-religious way as an approach to the development of parapsychism.

Parapsychism is this proposal a competence to develop or spiritual intelligence that helps to the people to find the meaning of everyday actions, cultivate self-transcendency and clarify the purpose of life. Without parapsychism people are more vulnerable to manipulations and salvationism.

According to Cirera (2014), the parapsychic intelligence allows the development of a healthy condition of evolutionary self-sufficiency, which leads to major responsibilities with others.

According to Barušs and Mossbridge (2017), consciousness is primary and physical phenomena is secondary. This new perspective of the science of consciousness presents the notion that mind is transcendent in nature which means that cannot be correctly characterized in physical terms. Scientific innovations valued to sustainability challenge rely on new paradigms that overcome materialism or physicalism.

The experiments of Vieira (1994) clarify that parapsychism is the ability to perceive and master bioenergetic foundations of the complex multidimensional reality of consciousness by broadening the ethical perception in all possible relations with the Cosmos (Cosmoethics).

Bioenergetics is the study of bioenergy or the energy of life. This bioenergetic approach is fundamental to understanding the results of Integrative Medicine related to the concepts of Chi in Traditional Chinese Medicine and Prana in Traditional Indian Medicine (Ayurveda).

The phenomenological approach to gradual expansion of consciousness and the principle of disbelief presented by Schlosser (2017) can generate new, more libertarian ways of spirituality and self-transcendence, making them accessible to all.

In this context, the project to promote integrative health develops the notion of spiritual health expanding to a non-religious approach. Spiritual health comes to be seen as the consciential health and encompasses states of expanded awareness, care of bioenergies and observance of the cosmoethics in all relationships.

This parapsychic approach opens possibilities to understand bioenergetic and spiritual dimensions of health rationally and expands the idea of well-being to include bio-***energo***-psycho-socio-ecological-***consciential*** perspectives.

The paradigmatic invisibility of bioenergies resembles the invisibility of microorganisms in the pre-microscopic era. Prioritizing and valuing bioenergies and multidimensional aspects of consciential reality in everyday life represents a challenge for lifelong learning of the principles of integrative health.

6 Evolutionary Intelligence

The key to the integrative health promotion is people's competence or aptitude to evolve, promote recycling or changing for the better. The healthy integrative people are those who cooperate more to form a better social network. Also, include those individuals with more capabilities or skills in the articulation of salutogenic principles with learnings cultivated by high-quality education of consciousness to change lifestyle and living conditions.

The intelligence to know how to change or evolve in a teleological sense of continuous improvement throughout life is called evolutionary intelligence. According to Vieira (1994), evolutionary intelligence qualifies human interests and priorities.

We need to recognize ourselves as multidimensional beings (biological, bioenergetic, emotional, mental, social, ecological, cultural, and spiritual) and learn to develop conscientiality or the quality of being a consciousness in the process of evolution.

Increased conscientiality or self-transcendence makes people mature through life experiences. The challenges of sustainable development depend on the level of conscientiality of individuals who can see the integration of their own health with other people's health, the environment's health and the health of planetary ecosystems.

In this proposal, the quality of social life reflects the level of conscientiality of its members, and especially its leaders. Investment in the consciousness education improves the quality of social capital of communities and cities.

According to Bowling et al. (2002), the multidimensional model of quality of life shows that as people age, greater well-being is the consequence of multidimensional aspects of environmental, relational and functional health. Evolutionary Intelligence enables consciousness to deal with a progressively larger number of multidimensional variables.

Thus, happy, healthy and ethical people are empowered to act in favor of integrative health for all life forms, and in different living spaces, and to, in summing up, express the essence of the challenge of sustainable human development.

Education of consciousness for integration combined with integrative health approach promote higher evolutive intelligence and quality of social life with increased systemic awareness to generate a new human ethos, a new, more sustainable lifestyle or *Homo sustentabilis*. This concept was still little explored, Renders (2013) promotes a secular and religious approach.

7 Conscious Cities

According to United Nations (2014), in 2014 54 percent of the world's population was urban. The trends in urbanization expect the continuing growth of urban population so that by 2050 two-thirds (66%) of the world's population will live in

cities. Considering the scenario in which the future of humankind is threatened by the Anthropocene Age characterized by alienation, lack of awareness, lack of presential strength and lack of connection that result in the chronic illness of populations and the planet itself.

In this context, it is up to us to present a new proposal, that of Conscious Cities, in which the individual and the community practice conscious citizenship in favor of the common good and a high quality of life. Conscious communities promote participatory learning spaces and help to transform and build interpersonal relationships with more conscientiality to develop the fair and sustainable integration of elements of the planetary ecosystem.

Conscious Cities make it possible by improving the social capital through education of consciousness to integration. Integrated people became health assets with better capabilities to promote integrative health that make viable health culture and healthy cities. Then it will be possible to create cultural conditions for the improvement of new economic alternatives such as conscious capitalism (Mackey and Sisodia 2014), regenerative capitalism (Fullerton 2015), sustainable capitalism (Gore 2013), or other models that promote the evolution of capitalism and make the sustainable development viable.

Scharmer (2016) presents arguments to explain that the evolution of capitalism results from the evolution of consciousness.

Considering the negative impact of today's preponderant economic model on planetary life, the above alternatives to savage capitalism are emerging as proposals for sustainable development. All these new approaches share new forms of production of goods and generation of values, such as the solidarity economy, biodynamic agriculture, and organic farming, which seek integration and adoption of a notion of health consistent with integrative health.

Consciousness and integration will be fundamental concepts for sustainability in the 21st century since it is tacit that the economic model and values of today's society need to be revised, redesigned and recreated to ensure the sustainability and diversity of life on the planet. The humankind needs to encompass a higher level of lucidity and discernment about all sustainable development goals. International cooperation to improve the Education and the Science of consciousness globally will help the implementation of the conscious cities. Conscious citizenship allows a better quality of social network to the development of healthy and sustainable cities.

The spheres of sustainability (Fig. 1) represent the organization of core processes of promoting the sustainable development goals in the cities. Each small sphere supports the next. Lifelong education of consciousness is the heart of sustainable development according to this model.

In the author's experience, the practical implementation of this approach to the education of consciousness for integration and promotion of integrative health was possible and occurred in the two projects developed in the Cultivating Good Water (CAB) program. One focusing on environmental educators who become multipliers and the other focusing on public school teachers who promote didactic exemplarism for their students.

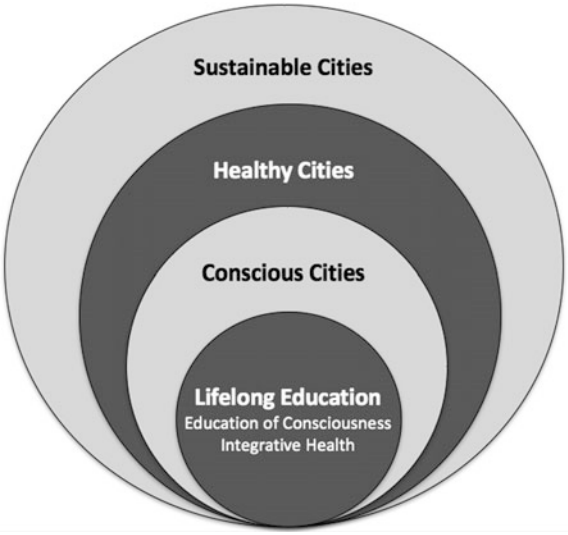

Fig. 1 Spheres of sustainability

Lifelong learning with a focus on education and re-education of consciousness to cultivate and promote integrative health generates the empowerment of people to qualify the social capital. Conscious Cities support Healthy and Sustainable Cities and enable Healthy People Living on a Healthy Planet as the all-embracing synthesis of global efforts over the indicators of the sustainable development goals.

8 Conclusion

According to possible future scenarios presented by authors cited in this text, the present time is critical to the destiny of current and future generations of all earthlings. It is a period that demands a strong ethical commitment to life and nature. Facing global threats created by Anthropocene Age and *Homo economicus*, all areas of human society are beginning to translate their disconnected efforts into an integrated approach to produce the innovations required by the challenge of sustainable development.

Notwithstanding the fears and preoccupations related to the future consequences of the lack of presential strength, alienation, and carelessness of contemporaneous civilization there are infinite and unexplored potentials inside each human consciousness.

All the most sophisticated high-tech innovations are relatively too simple in comparison to the human brain and the consciousness that create those technologies. The Education and Science of consciousness is a key to create a new paradigm of sustainability because the integrative power of consciousness is necessary to achieve the objectives of sustainable development by 2030.

Despite limitations of this theoretical work, it has been possible to develop practical experiences of significative personal and social transformation at 29 Brazilians cities in two programs of the internationally recognized program Cultivating Good Water. These experiences of promoting integrative health through education of consciousness for an integrative and systemic perspective opens the possibilities for innovations in the fields of environmental education and health promotion.

The time and space constraint to produce this text have imposed limitations to an in-depth exploration of this integrative approach to the conscious education. Even though, the seven learning priorities (volitional, intentional, self-organizational, maxifraternal, intellectual, communicational and parapsychical learnings) to educate and re-educate consciousness for cultivating integration and promote integrative health represent an initial systematic revision of interconnected studies to build a proposal of a curriculum for the education of consciousness.

The main reason to support this integrative approach to the health of people and the planetary ecosystem is the simple idea that almost every scientific effort until now result in insufficient solutions limited by the Cartesian and materialistic paradigm. The complex challenges of sustainable development need a more comprehensive, systemic and integrative paradigm of sustainability to guide new scientific endeavors. Scientist of all scientific fields have possibilities to encourage more interdisciplinary, innovative and integrative investigations that provide better scientific pieces of evidence related to sustainable problems. The new integrative evidence is fundamental to foster the translation of knowledge for the public through the lifelong education of consciousness for integration of environmental, social and economic aspects of the reality in a salutogenic, systemic and sustainable methodology.

The conscious cities are a priority to support healthy cities that promote sustainable cities. This systemic approach to an integrative citizenship can help the design of better strategies to the health justice and the social equity. Further investigations on conscious cities are necessary.

Well-integrated communities of conscious people or the new *ethos* of *Homo sustentabilis* with improved critical sense, better level of systemic reflexion and more intellectual autonomy lead to more healthy and sustainable individuals, communities, cities, societies and all planetary ecosystem.

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Achieving Sustainability in the City of Winona, Minnesota (USA): A Case Study

Bruno Borsari, Neal Mundahl, Anne Morse, Pat Mutter and John W. Howard

Abstract The City of Winona is a small urban center (27,500 people) in southeastern Minnesota. Located along the Mississippi River, the city is nestled below steep bluffs that limit further urban development. Winona's riverine location has been shaping its economy for the past 150 years, enriching a culture and history that persists to the present day. In addition, the area's fragile karst geology has focused attention on the management and protection of soil and water resources since early-settlement days. Consequently, sustainable development has become a solid cultural construct within the community for several decades. Citizens have been striving to achieve a sustainable life style and economy through on-going conservation efforts, continuing to make Winona a distinctive tourist destination in the Upper Midwest region of the US. Our work focused on several sustainability objectives (or indicators) to be achieved, specifically urban agriculture, composting, parks and green areas conservation, urban landscaping to attract pollinators species, water quality, sustainable tourism, and recycling. The city participates in the County's recycling program, which is one of the state's top programs for citizens' participation and volume of recyclable materials per capita. This chapter will illustrate both the challenges and opportunities for pursuing sustainable development in Winona based on the seven indicators listed above.

Keywords Case study · Cities · Sustainability indicators · Sustainable development · Winona

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1 Introduction

Urbanization, the outcome of the industrial revolution and human migration, produced a massive ecological transformation over the past 200 years. However, according to Rees and Wackernagel (1996), this process also has become pivotal in framing sustainability. Urban sprawl continues to be extremely damaging to lands and the ecological services the lands provided formerly, while also causing further loss of carbon to the atmosphere (Sallustio et al. 2015). The City of Winona, Minnesota, is not exempt from these scenarios, following a comparable socio-economic and development trajectory similar to those of many other urban areas in the western hemisphere.

Winona is located along the banks of the Mississippi River in the southeastern part of the state (44°N and 91.7°W). Its 'karst' topography with soluble rock formations and the unique glacial history of the Driftless Area of the upper midwestern US shaped its distinctive landscape features (Mundahl et al. 2015; Fremling 2005). The steep wooded bluffland and deeply incised stream valleys resulting from the karst and Driftless conditions attract many visitors each year. Prior to European settlement in the mid-1800s, it was home to the native Dakota people of the Sioux Nation. The city's name honors Wenonah, said to have been the first-born daughter of Chief Wapasha. The latest population estimate for the City of Winona counts 27,591 inhabitants in 2015 (Minnesota State Demographic Center 2016).

The natural attributes of the landscape surrounding Winona and the history of this riverine town have contributed through the decades to make this community a destination for tourism, art, and education. Although the timber industry initially shaped its economy, innovation and technology have been establishing many other enterprises (e.g., composite materials, electronics, and others), increasing the demand for skilled, educated professionals. The city's oldest institution of higher education, Winona State University, opened its doors in 1858 to prepare school teachers for the pioneer communities that were expanding west of the Mississippi River. In more recent times, St. Mary's University was established in 1912 and Minnesota State College Southeast in 1949, all contributing to prepare the labor force within this geographic area.

A renovated interest in sustainability and natural resource management, instituted by the new city manager, was instrumental in creating and filling the position of Natural Resources Sustainability Coordinator in 2016. This new professional figure is responsible primarily for the management of stormwater within the city (50% of position) and for promoting and implementing sustainability projects, programs and demonstrations (remaining 50%). The latter will be pursued by developing a sustainability plan, which will provide more extensive guidance to the City of Winona while it pursues a more sustainable development in future years. Although a vision for sustainability is still in its initial phase of evolution, Winona has shown a keen interest in sustainable development for several years. Sustainable development in the area has emphasized soil and water conservation, as a majority of peoples' livelihoods depend on agriculture (Mundahl et al. 2015).

A collaborative of citizens' organization, local governments and educational institutions called Sustain Winona has been serving for the last decade as the hub of a partnership committed to achieving sustainability.

Our study examined the past levels of achievement for selected sustainability indicators in Winona, and attempted to verify their efficacy in the present. We envision this effort continuing into the future, and view this contribution as necessary to summarize the experience gained in Winona, while also consolidating priority goals and pace for further achievements. An ongoing effort to educate and engage citizens and groups ensures that the 'cultural milieu' will continue working effectively towards sustainability in our community. The large student population of Winona supports the need for this study, emphasizing the transformative education potential and implications for sustainability when schools and their learners become engaged in such a process.

2 Efforts and Achievements Toward Sustainable Development

The impacts of global urbanization remain a constant reminder that the industrialization process, which began in Europe and the northern hemisphere in the latter half of the 18th century and accelerated during the first half of the 19th century, has been expanding rapidly to the rest of the world. This trend has been generating many concerns as it tends to jeopardize quality of life and create a sharp economic polarity among countries, often leading to social instability (Rees and Wackernagel 1996). In addition, a fast deterioration of the environment and a rapid depletion of its resources is undermining the capability of cities to achieve sustainable development, especially affecting urban areas and their inhabitants in developing countries (Riffat et al. 2016). Winona has physical constraints that limit its urban expansion, because it lays on a finite sand bar along the Mississippi River, bounded by steep bluffs that characterize this distinctive river valley (Fremling 2005). Nonetheless, the city is not immune from challenges to sustainability as demonstrated by pressure in recent years to develop the bluffs, or expanding farming operations, or extracting silica sand (abundant in the area) for hydraulic fracturing purposes. Ultimately, achieving a balance between resource use and conservation, while maintaining acceptable levels of environmental quality to ensure a livelihood to its inhabitants, remains an on-going effort and a commitment for Winona. In this chapter, we wish to present our achievements and discuss potential priorities to develop a more robust framework and action plan for sustainable development within our community.

3 Sustainability Indicators: The Magnificent 7

We focused our work on seven indicators of sustainability and the community's performance on them over the past 10 years. This indicators list is not exhaustive, but serves as a starting point to demonstrate several aspects of sustainable development in a continuous education effort aimed at engaging an increasing number of students (Borsari 2016) and its citizens.

3.1 Urban Agriculture/Community Gardening and Landscaping

Food production and security always has been a pivotal factor in the long-term prosperity of human civilizations (Diamond 2011). Consequently, the design, structure, and expansion of the urban environment have been linked to the capability of society to maintain productive food systems and edible landscapes. Looney (2014) emphasized the potential of urban horticulture with a focus on food production, and advocated for the opportunities of a research agenda, focusing on alleviating poverty in expanding urban environments. Winona has a long history for

Fig. 1 Harvest celebration at Wapasha community garden at the end of the summer of the first growing season (2009)

growing food in the city that goes back to the Victory Gardens of the 1940s (R. Gallien, long-time Winona area farmer, personal communication), and through the decades community gardens have remained a constant interest among many city residents (Fig. 1). Research indicates that people will engage in community gardening not only to grow plants in a healthy manner, or to spend time in the outdoors, but primarily to interact with other people in the community (Flachs 2010; Jones 2012). During the last 10 years, Winona has been home to three community gardens (Redeemer, Wapasha, and Watkins), plus a recent fourth (Stone Point Gardens) that is located less than 10 km from the city on county property. Wapasha and Watkins were not allowed to renew their leases with private property owners in 2012 and 2013, respectively. However, a new, raised-bed community garden was established at the City's East-End Recreation Center in 2017.

An inherent challenge with community gardens in urban areas is that space is at a premium, and Winona is no exception. As shown by the termination of the Wapasha and Watkins gardens, continuity with community gardens requires long-term support from the property owner. One solution may be to establish gardens on public property since public property is less likely to change ownership, or use type. Also, the support of city stakeholders is another vital component for success. Since 2009, Winona community gardens have been engaging approximately 400 gardeners and their family members. The majority (67%) of the gardener population consisted of women. By considering additional family members and/or groups (e.g., students from local colleges) who were engaged in gardening through the years, this population might have exceeded 1000 individuals. We are cognizant that food production in the urban environment is a pivotal tenet for sustainable development for any city, yet it remains a component of several facets that contribute to achieving sustainability, as predicated by permaculture design and philosophy (Hemenway 2015).

Using native plant species in the design of the garden enhances biodiversity and ecological benefits for the landscape. Borsari and his collaborators (2014) called these green spaces "microprairies" because keystone species in these and similar gardens are the grasses and forbs of the native plant community that characterized southeastern Minnesota and most of the plains region before European settlement.

3.2 Composting

Composting food waste and plant biomass from city parks and private properties has occurred in Winona for a long time. Within this context, Richard Gallien, owner of The Winona Farm, is considered the distinctive, iconic figure for composting in Winona. He began composting shortly after purchasing the farm in 1956. His 70.85 ha property is located about 5 km from the center of Winona just beyond the city limits. For several decades The Winona Farm has been collecting food waste from restaurants, grocery stores, and school cafeterias. It also receives leaves, grass clippings, and other garden waste from thousands of home owners in the city

(see also http://www.thefarm.winona-mn.us/compost.htm). The resulting compost has started making its way back to the city as the main soil for the East End Recreation Community Garden, thus restarting the cycle.

Winona also offers a small compost site within city limits (https://www.cityofwinona.com/city-services/public-works/compost-site/), although the facility does not receive nearly the volume of Mr. Gallien's farm. Interestingly, the city utilizes the Winona Farm as the compost site for hundreds of truckloads of leaves each fall. This is due to the terms of the contract that Winona has with the city's compost site operator, and the sheer volume of leaves collected from the city's roadways.

3.3 Recycling

The recycling program in the city of Winona and Winona County is the sustainability indicator of greatest success. The well-established curb-side recycling program, overseen by the county Sustainability Coordinator has a participation rate of 96% of its population, which is unparalleled in the state of Minnesota. The program has a very high satisfaction rate (95%), with 90% of residents believing that recycling is of high importance to the community. Most participants in the recycling program (76%) reside in town, whereas the remainder (24%) live outside of the city limits in Winona County (Winona Co. household hazardous waste. Annual Report 2015).

The city's residents are also served by a successful county wide household hazardous waste program, which includes collecting pesticides, fluorescent bulbs, flammable fluids, latex and oil based paints, dioxins, acids, bases, oxidizers and pharmaceutical products. The cost of household hazardous waste (HHW) disposal, total mass (Kg.) disposed, number of participants, mass (Kg.) per participant and associated disposal costs per participant are reported for the years 2011–2015 (Table 1). In addition to responsibly disposing through HHW, the County provides a "Used Product Exchange" room where residents can drop off still usable materials, primarily paints, for other residents to use. This service diverted over

Table 1 Summary data about household hazardous waste in Winona County between 2011 and 2015

Year	Disposal cost ($)*	Tot. mass (Kg.)	Number of participants	Mean mass (Kg.)/participant	Cost/Participant ($)
2011	53.624	40.162	2.823	14.22	19.00
2012	59.110	43.265	3.125	13.84	18.91
2013	53.672	39.402	2.770	14.22	19.38
2014	59.913	40.323	2.819	14.3	21.25
2015	59.705	44.057	2.924	15.06	20.42

*Disposal costs are based on Minnesota State contracts
(Adapted from: Winona County Household Hazardous Waste. Annual Report 2015)

25,000 Kgs. of materials from 2011 to 2015 while saving the County nearly $17,500 in disposal costs over that same time period. The product exchange also saves residents money and lowers their environmental footprint since they do not need to buy new products.

3.4 Green Space and Parks Maintenance in Winona

Management of city parks and green areas in Winona has taken a more sustainable trajectory since the hiring of a new city manager in 2016. In recent years, city residents have become increasingly concerned about the loss of bees and other pollinators, amplifying pressure on city stakeholders to seek alternative methods to control weeds and pests. In late 2016, driven by a citizens' initiative, provisions were enacted to limit the mowing of vegetation surrounding the very popular Lake Winona in order to enhance water filtration as well as to provide wildlife habitat. While the mowing plan was being implemented, a local group called the Winona Area Pollinators worked successfully with the City to pass a resolution to protect pollinators. The "Pollinator Resolution" as it now called has five main components: employee education about pollinators, using pollinator friendlier pesticides, establishing pollinator habitat, protecting habitat and nesting areas, and sourcing neonicotinoid free plants. The city also is working to implement integrated pest management (IPM) approaches for controlling populations of insect pests like mosquitoes that can transmit several viral pathogens during summer months.

Enhancing and maintaining native plant health in urban environments is an approach to sustainability that is becoming ubiquitous in cities of any size (Riffat et al. 2016). Prairie gardens (Borsari et al. 2014), rain, edible, herb, and roof gardens all have strong potential to improve the sustainability of an urban environment, so these alternatives to a typical lawn landscape are encouraged in Winona, Minnesota.

The establishment of the Landscape Arboretum on the campus of Winona State University in 2014 and the distinctive recognition of the university becoming a Tree Campus USA were successful efforts in sustainability. A survey of the campus tree community quantified the economic value that trees provide to the campus for esthetics and the various ecological services they provide (Borsari et al. 2017). This is a tangible demonstration of the effort toward educating the community to better understand the need of establishing green spaces in the city, while developing management practices for the plants that are more environmentally friendly.

3.5 Water Quality

Water management and control of its quality while limiting run-off are priorities to achieve sustainability in the city of Winona. More sustainable maintenance of parks

and green spaces aid in improving water quality, but many other efforts are under way. Effective strategies for water capture include the design and installation of green roofs. Although their maintenance will require the use of irrigation (Van Mechelen et al. 2015), roof top gardens can effectively manage water. At the moment, the only roof top garden in town is the one that was installed at the Sustainability House on the Winona State University campus in 2012.

The city of Winona has also been promoting residential rain gardens since 2015, with modest grants awarded to five residents to demonstrate the environmental benefits of these features. Additionally, two municipal parking lots now feature small rain gardens, and the city has partnered with local businesses to help maintain them. One of these was installed next to the local food coop (Bluff Country Coop) in 2016 after the coop secured grant funds for the construction. Unfortunately, successful rain garden construction has been challenging. In some cases, run-off laden with sediment has clogged the pore space of the garden's water infiltration areas, and made the gardens into unintentional stormwater ponds. Standing water in the ponds led some residents to fear mosquitoes would use the raingardens as breeding grounds, or misunderstand raingardens to be havens for weeds. These demonstration projects are periodically featured in articles from the local media as well as op-eds both opposing and supporting the projects. The visibility of the raingardens certainly has led to public awareness about the projects, and hopefully the successes and failures in Winona will educate residents and visitors about landscape design and gardening actions they can take on their own properties to promote a sustainable urban environment.

One of the strongest local motivations to improve water quality is that the very popular Lake Winona, which is surrounded by the most heavily used park in the city, is classified as an "impaired water" by the primary state environmental regulatory body, the Minnesota Pollution Control Agency. High levels of phosphorous cause the lake to be listed as impaired, and plans to improve the phosphorous level are being written in 2017 (Mundahl and Hoisington 2017). Funding for these plans comes from a state entity called the Board of Soil and Water Resources, which is one of several state entities that addresses water quality. In general, state water policy has helped protect local resources. Two specific examples are the state ban of phosphorous in residential fertilizers, and requiring Winona (and all cities of a similar or larger size) to monitor their stormwater infrastructure.

3.6 Tourism with a Sustainable Development Focus

Tourism plays a very important role in Minnesota, and is considered the 2nd largest economic force in the state, following only agriculture. People have been coming to Winona since its early establishment for reasons related primarily to its industries (e.g., lumber, stone cutting, glass blowing), and more recently for employment in manufacturing, electronics, engineering, and nanotechnologies. Therefore, work and/or business opportunities created the initial force to attract people to the area,

and under this impetus, the hospitality industry developed a step further, with many hotels, bed & breakfast facilities, and restaurants. These businesses amplified tourism through the decades, and the natural beauty of the riverine town and its surrounding landscape made Winona a destination for leisure and eco-tourism, prompting development of programs that to this day provide the main dollar revenue for its economy.

The arts and education also are significant components that draw tourists to Winona throughout the year. Winona's Minnesota Marine Art Museum, notable events like the Frozen River Film Festival, Great River Shakespeare Festival, and Beethoven Festival draw artists and visitors from around the country. Great outdoor opportunities abound from the river to the bluffs, and the nearby Trempealeau National Wildlife Refuge serves as a starting point for the Great River State Trail where you can bike or walk alongside the Mississippi, all the way to La Crosse, Wisconsin (Wallijasper 2015).

It remains to determine whether the tourism industry embraces and supports a philosophy of sustainable development, apart from the economic viability of the industry, and Winona is no exception. According to Hunter (1997), "sustainable" tourism has evolved in isolation from the continuing debate on the meaning of sustainability, resulting in a model of sustainable tourism that often remains simplistic and oblivious to the many other components that are necessary to achieve sustainable development.

In addition, preparing managers and leaders in the tourism industry to employ a culture of sustainability could be a priority feature, as was presented in a recent assessment study from Malta (Misfud 2016). The author advocated educating hotel managers about the cycle of food, from local production to disposal, and increasing the number of field experiences for students interested in the pursuit of this career path. In addition to this, Briassoulis (2002) contended that holism is the approach to employ when developing sustainable tourism, and this should include management of resources (both natural and human) well integrated with design policy and implementation.

In February 2017, the local tourism organization Visit Winona was honored with the Marketing Excellence award from the Explore Minnesota Tourism agency, which serves as the state's primary marketing organization. The mission of Visit Winona, which is funded by a nominal lodging tax levied at local hotels, is to promote Winona as a tourism destination. Research specific to Minnesota suggests that for every dollar spent on advertising, approximately $98 is generated in tourism spending. This was Visit Winona's second Marketing Excellence award, the first one coming in 2013 for its successful social media campaign (From: 2/20/2017 Winona Post). This recognition substantiated the distinctive attributes of Winona and the increasing role it is acquiring as a hub for recreation and the arts in the Midwestern US. Tourism in Minnesota is a $14.4 billion industry that generates $930 million in state sales tax and >250,000 jobs. In Winona County, the tourism economy generates $103 million and employs approximately 2300 people, while generating nearly $7 million in state tax revenues (Table 2).

Table 2 Selected economic data and employment produced by the tourism industry in Winona County, in recent years

Year	2011	2012	2013	2014	2015
Gross sales ($)	81,978,367	93,844,551	95,921,247	98,293,435	103,644,500
State sales tax ($)	5,593,306	6,407,935	6,491,433	6,650,028	6,997,585
Employment generated	2113	2448	2320	2331	2298

Available at: http://www.exploreminnesota.com/industry-minnesota/

4 Sustainability Education as Community Emphasis

An education focusing on sustainability should inspire and motivate everyone to better understand the complex matrix of issues and challenges that characterize approaches and processes directed at achieving a sustainable development. Keystone concepts like the ecological footprint and its method to calculate it may assist successfully to engage citizens in a discussion about sustainability (Wackernagel and Rees 1996). Reckoning with the fact that even with best management practices every person, business, or organization carries what Onwueme and Borsari (2007) identified as a "sustainability deficit", should elicit more interest in wanting to develop increasingly sustainable living styles. For these reasons, pursuing education in sustainability remains a very ambitious goal and ever more complex endeavor that, despite the challenges, remains an imperative effort of present education (Borsari 2016). A recovery from the erroneous assumptions of supporting extractive economies that continue to predicate a limitless expansion of markets and affluence as achievable tenets to enhance quality of life demands instead a focus in education directed to strive for a more sustainable development. Winona is a notable college town with two universities and a community/technical college. The leadership of these institutions of higher education could have a significant effect on the sustainability education of thousands of students who continue their studies within our community.

A recent assessment of curricula in sustainability by O'Byrne et al. (2015) indicated that programs in sustainability have proliferated worldwide, and although there are broad differences among these programs, sustainability has become established as a reputable and legitimate academic field. Also, an employment of indigenous knowledge and a strong focus about 'place' are important concept features in education programs in sustainable development (Dockry et al. 2016). Although concepts of sustainability may be taught in a variety of courses in Winona, the only structured curriculum currently in existence is a minor field of study (18 credits) offered by Winona State University. In addition to this, a few courses in renewable energy and sustainable development are offered through the Department of Outreach & Continuing Education. However, educating about sustainability should not remain the sole responsibility of schools, colleges and

universities but also involve more organizations to reach out to all strata of society more directly, through consistent education efforts that are inclusive and solidly anchored on citizens' interests and participation. In Winona for example, more education programs in sustainability include the Master Gardeners, an initiative led by the local extension office of the University of Minnesota. The Clean Energy Resources Team (CERT) of the University of Minnesota has a notable program which includes conferences, workshops, and visits to demonstration sites about renewable energy sources that also occur periodically in the Winona region. The Land Stewardship Project (LSP) is another organization (non-profit) that aims to educate farmers and land owners to manage their operations more sustainably. LSP also offers a distinctive 6-month program to young people who wish to embark on a farming career. This program is primarily experiential with several hands-on activities and field visits. Also, it allows learners to connect with farmers who are approaching retirement and who may be interested in passing their land to new farmers who share similar values about management and resource use, with sustainability as a pivotal focus.

5 Discussion

The overall pursuit of sustainable development in Winona, Minnesota aims at becoming more integrative in its design and increasingly adaptive in its management. The achievements pursued in recent times are of great inspiration to move forward in this direction and continue to expand efforts to achieve sustainability in our community. Our recommended approach to sustainable development is inspired by theories and principles of permaculture that as Hemenway (2015) suggested, is the needed *modus operandi* to reduce the ecological footprint of urban environments while making the same more resilient and regenerative. By the year 2100, it is estimated that the human population will number 11 billion, with 80% of people living in cities, making it imperative to continue working toward sustainability with consistent urgency, especially to insure clean, drinkable water for food, health, and sanitation in the urban environment (Koop and van Leeuwen 2016). Although permaculture has never been considered a typical academic discipline, its holistic approach to resolve problems created by faulty human design has been successful in a broad variety of circumstances and contexts (Ferguson and Lovell 2014).

Our vision for sustainable development in Winona is inclusive and the seven indicators that were presented herein are interconnected to one another. Recycling has been and remains a primary focus for sustainability and an effective analogy for renovation and renewability of the natural capital that the community has been endowed to manage to ensure a livable future for the generations to come. The same concept implies an emphasis on a culture of voluntary simplicity and conspicuous frugality that we strive to further develop to better understand that we all live within the constraints of only one planet Earth. Hence, in our philosophy of sustainable development, education plays a pivotal role. Although "education" is externally

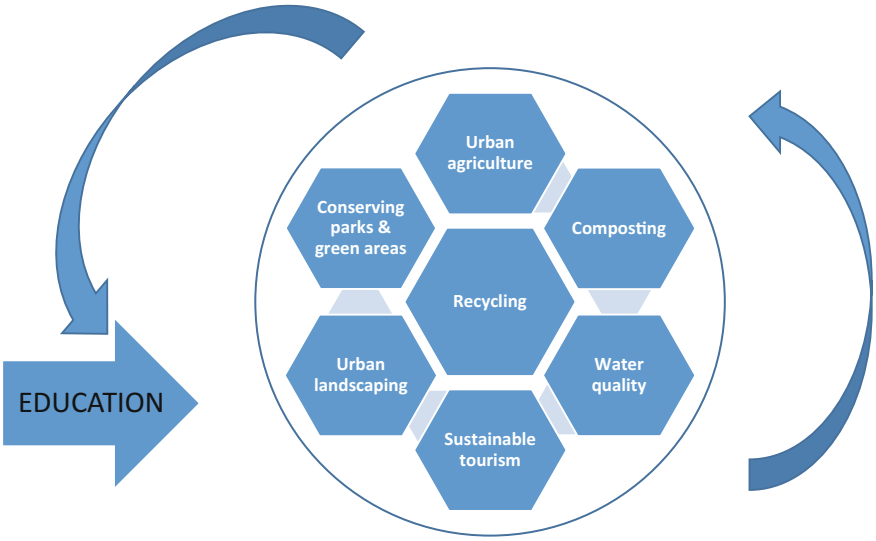

Fig. 2 Sustainable development model for the city of Winona, Minnesota

located in our sustainability model (Fig. 2), it embraces all indicators we considered in this study and the many more that will be considered in future evaluations about sustainability. Education is and will always remain the driving force that makes the circle of sustainability spin around the seven indicators of sustainable development in our community. The force education is capable of exerting upon the seven indicators is centripetal and centrifugal at the same time. It strengthens the links among these with possibilities to expand their efficacy a step further and allows inclusion of new indicators as the circle of sustainability enlarges by the effects of education on the Winona community.

Most importantly, education for sustainability empowers all learners and it inspires these to continue working toward a sustainable development as a community, with a robust sense of stewardship in mind. After all, an education for sustainability requires shifting economic development toward a more holistic and pragmatic approach to livable futures that prioritize the homeostasis of living systems; and this change is necessary now more than ever to address declining resources and increasing human needs (Borsari 2016). In order to achieve this it will be necessary to address the properties of living systems and ecosystems above all, while emphasizing that ecologically-informed decision-making is always necessary to tend towards sustainability, in present and foreseeable human endeavors. To this end, we give support to permaculture design as the theoretical framework of choice in future endeavors in sustainable development in Winona, Minnesota. Also, we remain attentive to the experience of other cities in the upper Midwestern US and beyond (McLarty et al. 2014) to guide our decision-making with holism in mind, a step further.

6 Conclusion

Sustainable development is a multifaceted construct and we recognize that even with the best plan of actions it will always be impossible to achieve 100% sustainability because of a "deficit" that inevitably impedes its full pursuit (Onwueme and Borsari 2007). Therefore, achieving sustainability will always remain a "work in progress" without exception for any city, enterprise, or system. Prioritizing a set of achievable goals appeared to be the most effective approach in pursuit of a more sustainable development in Winona. Our recycling program for example, became a distinctive feature for our city and county. Hopefully, its recognition in Minnesota will inspire more communities in the region and beyond to minimize the production of solid waste that otherwise would be disposed in landfills. Also, the leadership of groups and individuals who are committed to remain engaged in a continuous dialogue about sustainability constituted a pivotal factor for the pursuit of the indicators that were presented in this chapter. In sum, an establishment of a culture for sustainability demands with time a larger scale of community engagement. The production of a more comprehensive sustainability plan, which is under construction at present, will continue to guide future sustainability efforts in the city of Winona.

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Education and Lifelong Learning Sustainability: Windows of Opportunities Found in Brazilian Experiences that Address Agenda 2030 and Advocacy for Health Equity

Dais Gonçalves Rocha and Maria Paula Zaitune

Abstract Internationally Brazil is considered "an example of prioritizing social actions on Social Determinants of Health-SDH" (Marmot and Allen 2013 p. 73). It also took the lead in proposing declarations (Rio Political Declaration on SDH 2011; Rio+20 the future we want; The Summit of the People 2012) and signed others (New Urban Agenda-Quito Declaration on Sustainable Cities and Human Settlements for All; Shangai Declaration 2016), which recognize that health promoters must engage in advocacy for health equity and expose the adverse health consequences caused by current austerity measures, thus influencing public policies. This chapter proposes fulfilling the Sustainable Development Goals by creating a dialogue between literature and successful "windows of opportunities" experiences found in Brazil. These experiences are intersectoral actions and urban planning strategies tied to international health promotion agendas and the SDGs. Also, from the perspective of academia, the health sector takes on the role of leader in initiatives such as healthy universities that enable building advocacy expertise for future health workers and allow students to experience a sustainable environment during this auspicious phase of learning life skills.

Keywords Health promotion · Health advocacy · Equity · Competency-based education · Sustainable development indicators

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1 Background of the Dialogue Between Health Promotion and Sustainability

Studies on the early efforts of health promotion in Brazil in the 1990s identify two main elements that were essential for the Brazilian public health system (Buss and Carvalho 2009; Rocha 2001; Carvalho 1996). The first is related to the ideology or concepts that influenced the creation of Brazil's Integrated Health System (SUS). The second is related to the historical facts that enabled the institutional, legal, and financial conditions for health promotion.

An analysis of the first element involving the conceptual, political, and ideological scenario identified that the core principles of Brazil's health reform, which for the first time in history established in the nation's Constitution the right to health and the duty of the State, coincided with principles found in international documents on health promotion at the time. In March 1986 Brazil organized the 8th National Health Conference that included representatives from management, suppliers, workers, universities, and users and recognized the broader concept of health and social determination in the health-disease process. The 8th National Health Conference Report (Brasil 2009) defined its guiding and organizational principles as: universality, integrality in health, social participation, decentralization, and regionalization.

In November of that same year in Canada, the Ottawa Charter was launched as the main document (guideline) for promoting health in the world (Hancock 1998). Besides declaring most of the principles mentioned above, it added the prerequisites of peace, shelter, education, food, income, a stable ecosystem, sustainable resources, social justice, and equity.

This theoretical-conceptual connection or similarities between the principles of SUS and of health promotion was reaffirmed in the National Policy for Health Promotion (Brasil 2006, 2015), which was announced when Brazil proposed the following declarations: Rio Policy on DSS 2011 (OMS 2011); Rio+20: The Future We Want 2012; and Curitiba 2016. Brazil signed others (New Urban Agenda-Quito Declaration on Sustainable Cities and Human Settlements for All 2016; Shanghai Declaration 2016) that recognize that health promoters must engage in "advocacy to promote health and equity" in order to denounce the consequences of fiscal austerity and influence public policies.

Currently, it is important to recognize the convergence of the prerequisites of the Ottawa Charter, already in its 30th year, with the objectives of the Sustainable Development Goals (SDGs) that were defined in September 2015: No poverty; Zero hunger; Good Health and Well Being; Quality Education; Gender Equality; Affordable and Clean Energy; Decent Work and Economic Growth; Industry, Innovation and Infrastructure; Reduce Inequality; Sustainable Cities and Communities; Responsible Consumption and Production; Climate Action; Life Below Water; Life on Land; Peace, Justice and Strong Institutions; and Partnerships for the Goals.

These goals form a 15-year work agenda for the signatories and provide a framework for shared sustainable actions that target "people, planet, prosperity, peace, and partnership".

The principle of sustainability was included in the main points of health promotion in the Adelaide Declaration of 1988 when representatives from 42 countries affirmed: "This Conference advocates that, as a priority, the public health and ecological movements join together to develop strategies in pursuit of socioeconomic development and the conservation of our planet's limited resources."

However, it was only in June of 1991, at the 3rd International Conference on Health Promotion in Sundsvall (Brasil 2002), Sweden on Supportive Environments for Health, that the health promotion agenda was linked to other global movements. The Conference highlighted four key aspects of supportive environments:

> 1. The social dimension, which includes the ways in which norms, customs, and social processes affect health. 2. The political dimension, which requires governments to guarantee democratic participation in decision-making and the decentralization of responsibilities and resources. 3. The economic dimension, which requires a re-channeling of resources for the achievement of Health for All and sustainable development, including the transfer of safe and reliable technology. 4. The need to recognize and use women's skills and knowledge in all sectors - including policy-making, and the economy - in order to develop a more positive infrastructure for supportive environments (Brasil 2002).

The Sundsvall statement called upon:

> (…) the United Nations Conference on Environment and Development, which will be held in Rio de Janeiro in 1992, to consider the Sundsvall Statement in its deliberations on the Earth Charter and Agenda 21, which are considered the action plans for the next century. Health goals and objectives must be predominant in both documents. Only global action based on a partnership between all the nations can assure the future of our planet (Brasil 2002).

In an interview with Paulo Buss, the official Brazilian representative at Sundsvall, he reported that Brazil's participation in the conference led to the Rio 92 Conference where, in the same month, they launched a two-volume book through the National School of Public Health of the Oswald Cruz Foundation, published by Hucitec under the title: "Health, Environment, and Development" (Rocha 2001).

Buss again was the official Brazilian representative in the Global Consultation on Health and the High-Level Panel of Eminent Persons in the working group that formulated the SDG Agenda.

Furthermore, Buss et al. (2014) analyzed the addition of health on the post-2015 Agenda, focusing especially on the negotiations that took place between Rio+20 (2012) and the United Nations General Assembly—UNGA 2014, and on the projections for the UNGA 2015 when the process was scheduled to close and the SDG Agenda defined.

These debates took into account that growing environmental degradation and expropriation of natural and human resources required re-thinking concepts such as social exclusion. Social exclusion can be seen as a determinant of both the health-disease process and of environmental sustainability because of its significant impact on social equity. Moreover, the principle of equity is one of the main pillars

of public policies that includes health promotion and sustainable development (Setti et al. 2010).

Buss et al. (2014) recognized that the "health in all policies" strategy had been incorporated to an extent into the discussion when he identified health-related targets in SDGs other than the Good Health and Well-Being goal. Nonetheless, on a critical note they said:

> Interestingly, targets that mention health specifically are absent in SDGs of "economic nature" such as sustainable industrialization or economic growth and decent work. Health protection for workers in potentially hazardous environments, or actions against environmental pollution caused by productive processes, for example, are ignored in SDG 8 and 9, which shows the separation between economic and environmental issues and human health (p. 2562).

Gallo and Setti (2014) also criticized, stating:

> Structural causes of production and consumption modes and the unequal distribution of power, which produce inequity and impede real development, have not yet been addressed with the necessary radicalness, as can be seen in SDG8, SDG9, and SDG12. The latter especially has an extremely limited reach that is disproportionate to the ambition of the goal (p. 4391).

These critiques of the SDGs coming from Brazil reflect the accumulation of a prolific debate on social determination in the health-disease process in the country. The discussion follows two main tendencies. The first is based on the Rio Political Declaration on Social Determinants of Health (WHO 2011), which defines SDHs as life conditions, or in other words, the circumstances in which people are born, grow up, live, work, and get old. The WHO's SDH Commission and the various countries that implemented similar groups developed different metrics, research designs, and knowledge systems that are available for producing information on how the SDHs affect health.

According to Breilh (2013 p. 18) the SDH perspective "represents a paradigm of critical transition because it opens itself to the structural, thus breaking conventional epidemiology's strongest restrictions" because they include a broad set of social and political conditions that decisively affect the health of individuals and collectives. But he also argues that a Eurocentric bias "converts social structures into variables" (Breilh 2013) and fragments the reality of "factors" by supposing that they will maintain their explicative capacity when in isolation (Arellano et al. 2008; Almeida Filho 2004).

The second tendency is based on the studies and contributions of social determination of health in the 1970s (Laurel 1981; Donnangelo 1975) and on Latin American epidemiology (Breilh 2008). These authors see the resolutions of the WHO Commission (2011) as abstract. They believe there is only one main social determination: the capitalist economic system. The ways of production, consumption, and distributive logic—where the state plays an essential role—are determinants that configure the health, morbidity, and death profiles of social groups. This perspective in Brazil is advocated by Cebes in partnership with Alames through seminars, publications, and the distribution of position papers at WHO forums (Nogueira 2009; Arellano et al. 2008).

Internationally, Brazil is considered an "example of prioritizing social actions on social determinants of health—SDHs" (Marmot and Allen 2013 p. 73). These two debate tendencies were witnessed at a number of SDG preparatory events, such as the post-2015 Agenda consultation seminar and the Rio+20 follow-up led by the Brazilian Presidential administration in partnership with UNDP, conducted in Brasília in April 2013. Breilh called the different interpretations of these two tendencies of "scientific North-South division"

According to Buss et al. (2014 p. 2563):

> Furthermore, it becomes very clear that all the SDGs are in some way "social determinants of health" albeit health is not specifically mentioned in their targets. It is the case of eliminating poverty, education, gender equity, sustainable energy, infrastructure, inequities, cities and human settlements, sustainable production and consumption, and sustainable environments and biodiversity, for example.

This agenda and their recommendations can be seen in many of Brazil's government initiatives and public policies, such as the National Policy of Water Resources (1997), the Bolsa Família conditional cash transfer program (2003), the National Policy of Health Promotion (2006 and 2015), the National Policy of Food and Nutrition (2011), the National Policy of Agroecology and Organic Production (2012), the National Policy on Workers' Health (2012), the National Policy of Integrated Health for Field and Forest Populations (2013), the National Policy of Popular Education in Health (2013).

Today it is important to reinforce the need for supportive environments that guarantee greater social inclusion, fair and sustainable access to and exchange of information and goods and services of ecosystems, and caring for local and global environmental public assets.

2 Windows of Opportunities

In this section we propose a dialogue between literature and Brazilian experiences that indicate windows of opportunities for furthering SDGs. To accomplish this a literature review was conducted via BVS, Pubmed, Lilacs, and Capes databases using the descriptors "sustainable development" and "health"/"desenvolvimento sustentável" and "saude" (English and Portuguese) between 2012 and 2017. Twenty-seven documents were obtained from among articles and theses. The second phase consisted in reading the documents and classifying them as either interventions/experiences or conceptual, theoretical, or reflective. Next, experiences were selected that occurred in Brazilian territory that either analyzed or implemented sustainable actions and related them to human health. Six experiences fit these characteristics and constitute windows of opportunities for Brazil today.

This focus is justified by the professional experience of the authors in the process of organizing and conducting Rio+20 in Brazil, and in the meetings to discuss placing health on the Post-2015 Agenda, both in the context of environmental

health at the Ministry of Health or the thematic group for promoting health and sustainable development at the Brazilian Association of Collective Health (ABRASCO).

The first experience was with Building Integrated Public Policies in São Paulo, Brazil: the Case of Green and Healthy Environments Program (PAVS), which was implemented in the city of São Paulo. It used family health teams and took advantage of their easy access to the population to implement intersectoral actions and participative methodologies that greatly involved civil society. This allowed health promotion activities, especially education and environmental awareness activities, to spread and grow. These interventions improved basic human rights such as access to clean water, healthy environments, and safe shelter. Consequently, this experience was shared in a Pan American Health Organization publication in 2015, entitled Health in All Policies: Case Studies from the Region of the Americas (PAHO 2015; Sousa and Parreira 2010).

The second successful experience occurred in Mosaico da Bocaina, on the north coast of the state of São Paulo, just south of its border with the state of Rio de Janeiro. The area has several conservation units and 24 traditional communities of *Quilombolas*, *Caiçaras,* and native Brazilians. The Bocaina project used the "ecosystemic and communicative approach of strategic-situational planning" that produced partnerships and exchanges of knowledge and experience between the communities by encouraging local governance to promote healthy and sustainable territories that contribute to intersectorality, autonomy, equity, sustainability, and socio-environmental justice (Gallo and Setti 2012).

The third initiative was conducted in six municipalities in the state of São Paulo with the goal of understanding the socio-environment and its relationship with health in traditional rural settlements and in settlements defined as sustainable development projects. The subjects debated were: basic health; waste management; fighting erosion and deforestation; pest management and the use of pesticides; water source protection; zoonosis control; and workers' health. It was observed that the concept of sustainability that was prevalent in the settlements was limited to the productive process, the reduction of pesticides, and a focus on agroecology. The quality and quantity of water, the lack of sewer systems, and well as precarious living and working conditions seen amongst these population groups demonstrated and reinforced the difficulty of a broader understanding of sustainable development (Alves Filho and Ribeiro 2014).

The forth experience took place in the state of Bahia in a project conducted between July 2013 and June 2015 with 200 people from vulnerable *Quilombola* communities situated in Praia Grande on Maré island, and from Morené and Monte Alegre on Boipeba island. Nurses from the Federal University of Bahia's School of Nursing implemented social technologies to promote health and sustainable development, and to reduce poverty. The outcome, after training with members of partnering Brazilian universities, was the production of candies, natural fiber window blinds, and insulation boards, which generated income and consequently reduced poverty and promoted sustainability and environmental conservation (Oliveira et al. 2015).

Brazilian researchers also identified that water, draught, and health are on the SDG agenda, and thus proposed studying the Brazilian semi-arid region by analyzing indicators in four dimensions, one being health and three being sustainable development. The health indicator was the coefficient of infant mortality, and the social, economic, and environmental dimensions were defined by the following indicators, respectfully: % of literacy, % of non-poor people, and % with access to piped water. The conclusion was that these indicators improved in 1991, 2000, and 2010. Nonetheless, there are still gaps in health promotion and risk reduction for areas that are susceptible to draughts, and there is a need to: create intersectoral relationships and partnerships to help deal with the problem; overcome social and economic inequalities in these territories; and take into consideration the cultural values and aspects in order to improve and sensitize social participation in the decision making processes of planning (SENA et al. 2016).

The sixth experience was with the Urban Health, Environment, and Inequalities Program at the Federal University of Rio Grande do Sul (UFRGS). The program disseminated the use of UNDP's Human Development Atlas in different contexts and practical scenarios, such as in the community, the university, and in health services. To do this, the municipality of Porto Alegre was initially divided into participative budget regions, and later into micro areas that took into consideration internal homogeneity to configure the micro areas with socially similar structures called Human Development Units (HDU). Thus it was possible to use indicators such as infant mortality to compare health inequities in these territories. In practical terms, it showed an exponential increase in infant mortality when per capita income decreased, meaning it demonstrated that spatial segregation is an important factor in inequity. This study also identified the importance of the local community appropriating visual information such as graphs and maps in order to understand the reality they live in as compared to others, which can be an important instrument for health advocacy (Azambuja et al. 2016).

An analysis of these experiences identified the SDGs that are already part of the Brazilian agenda, specifically: Affordable and Clean Energy, Decent Work and Economic Growth, Reduce Inequality, Sustainable Cities and Communities, Responsible Consumption and Production, and Partnerships for the Goals.

The experiences reported in scientific literature privileged urban areas for implementing this agenda. This situation converges with recommendations by Kanuri et al. (2016): "Cities and local authorities are catalysts for change and drivers of development, as recognized in the recent post-2015 discussions." SDG 11 recognizes the central role of urbanization and sustainable development and calls for "mak[ing] cities and human settlements inclusive, safe, resilient, and sustainable."

Although the Healthy Universities and/or Health Promoters initiatives did not appear in the literature review, they are considered fundamental in promoting advocacy skills for health professionals, and in helping students experience a sustainable environment during this auspicious phase when they learn life skills.

Since Sundsvall in 1991, the following objectives and strategies were identified to connect environment and health from the perspective of sustainable development:

> 2 – Equip communities and individuals to control their health and environment through education and empowerment. 3 – Create alliances for health and for establishing supportive environments to strengthen cooperation between the health strategies and actions promoted by health and environment. 4 – Mediate conflicting interests in society in order to ensure equitable access to health environments.

Another area that has been recognized as able to promote healthy environments is universities and/or higher education institutions. This is where we see the Healthy Universities project emerge as one of the healthy environment strategies, as identified by some authors (Mello et al. 2010):

> 1 Universities are institutions where many people live and experiment different aspects of their lives: people learn, work, socialize, and use their leisure time, in addition to, in most cases, using the services provided. Universities, therefore, have significant potential in using all their capacities to protect the health and promote the wellbeing of students, staff (academic and others), and the community through the policies and practices it employs; 2 Universities train students that are or will be professionals and policy makers with the potential to influence the conditions that affect the quality of life of people. By developing research and the political-pedagogical project, universities can expand knowledge of and commitment to Health Promotion with a vast number of trained and educated people in various fields of work. This includes, therefore, the commitment of not only health professionals, but also of those in social areas, technology, and humanities; 3 Its community actions opens opportunities for things such as good practices related to Health Promotion and using its influence to benefit the health and quality of life of the local, national, and international community (Mello et al. 2010 p. 685).

The university campus is usually where students in the field of health spend most of their day. In addition to being a place for learning, many academics and staff use the university to eat their meals, to relax, and other things. Thus, spaces that stimulate good quality of life are necessary.

The fifth criteria in *Red Nacional de Universidades Promotoras de Salud*—REDUPS of Chile (2013) requires that the "the promotion of health be part of the curriculum components for graduation" in higher education institutions seeking certification as a Health Promoting University (HPU). In Brazil, Mello et al. (2010) had already indicated that the proposal for health promoting universities be tied to the agenda for changes in professional training.

Although HPU proposals date back to the 1990s (Tsouros et al. 1998), scientific production on the subject is still in the beginning phases, especially in the Portuguese language. Even in places with developed HPU networks, there are numerous knowledge gaps and few evidence-based discussions.

In 2014, the Faculty of Health Sciences (FS) at the University of Brasília in Brazil began investing in sustainable and protective spaces. In 2016 it became a member of the Iberian-American network of health promoting universities. One of the pillars of this initiative is an objective of the National Policy on Health Promotion: "to support the development of spaces for social production and health environments that add to human development and wellbeing" (Brasil 2014 p. 11).

Creating environments, spaces, and actions at FS included the faculty directors, interns, the academic community, and public servants. The focus of a Healthy University is to create projects **with** them, as opposed to **for** them. This

demonstrates the importance of everyone participating in order to certify that the community needs are met efficiently.

The listening and participation channels implemented by FS identified that students wanted: recycling workshops in partnerships with architecture and art programs conducted from the perspective of reducing garbage, to preserve the environment and the aesthetics of the university; seminars to advertise and implement health environments; academic projects to develop activities and promote health and social wellbeing and create alternatives that facilitate access to health information and actions.

In order to build local and national skills for establishing the principles of equity and participation in HPUs, we recommend using scientific production on the advocacy of equity (Farrer et al. 2015) to base health courses' curriculum.

3 Conclusions

The dialogue between health promotion and sustainability dates back to the 1990s and is based on many charters and/or declarations of national and international consensus. In the last six years these conferences have strongly recommended that health promoters engage in advocacy for health equity and expose the adverse health consequences caused by current austerity measures, which influence public policies.

It is important recognizes the convergence of the prerequisites of the Ottawa Charter, already in its 30th year, with the objectives of the Sustainable Development Goals (SDGs) that were defined in September 2015.

The Brazilian experiences described here include rural area processes and traditional populations, but they primarily depict the national agendas and instruments for urban planning in the country that are tied to the international agendas of health promotion and the SDGs.

This connection of agendas in Brazil is the result of temporal and political opportunities that reflect the following agendas: SDG 2030, Master Plans and Metropolitan Plans (Federal Law 2015: Metropolis Statute), Pluriannual Plans, and Health Plans, which can help bring together public functions and common interests.

Investment in Healthy and/or Health Promoting Universities is a healthy environment strategy whose potential is well described by many authors and international networks.

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Part V
Education and Lifelong Learning for Sustainability

Nature-Based Education for Resilient Cities

Jean-Pierre Schweitzer and Susanna Gionfra

Abstract Nature-based education, utilising green infrastructure (GI) including protected areas, presents an opportunity against the backdrop of environmental and socio-economic challenges faced by urban citizens. Evidence shows that improving access to nature-based education, can deliver multiple benefits to citizens of all ages leading to heightened wellbeing and resilience at the community level. Mental health benefits of exposure to nature include positive effects on mood, concentration, self-discipline and physiological stress. Amongst children, nature-based play and learning can support the development of motor-skills, self-esteem and emotional regulation. In social terms, nature-based activities, including nature-based rehabilitation (NBR), can help support the reintegration of minority and marginalised groups, facilitating community participation, cohesion and reducing urban tensions. In economic terms, public access to nature provides cost effective infrastructure, reducing pressures on public finances, alleviating poverty, as well as generating possibilities for employment and volunteering. Engagement with nature promotes biophilia and ecological stewardship amongst citizens, influencing consumption and mobility habits, which in turn reinforce the resilience and sustainability of entire populations. Agricultural learning in urban farms, allotments and CSA, help to bridge the rural-urban metabolic rift separating production and consumption. Finally, novel approaches to citizen-science can allow individuals to engage with monitoring and verification contributing to city level sustainability. This chapter explores the underutilised role of nature in supporting the education of urban populations across these aspects. It draws on evidence gathered in a yearlong research project for the European Commission, building on case studies from all 28 EU member states, in depth interviews, a two day conference, and a public consultation. The wider objective of the chapter is to highlight empirical evidence on nature based solutions (NBS), the multiple benefits of nature and urban GI.

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Biophilia · Citizens' well-being

1 Introduction

Access to nature and education activities taking place in natural environments can support the resilience of urban communities as well as wider objectives for sustainable development. Cities bestow citizens with opportunities and services not readily available in smaller settlements, however urban spaces also present a range of risks and challenges, such as air pollution, inequalities and social unrest (Arup and Rockefeller Foundation 2016). Research into the multiple benefits of nature and ecosystem services has demonstrated that access to nature in cities could be an effective tool to addressing some of these pressures (ten Brink et al. 2016). Furthermore, as demographic trends suggest increasing urbanization, and indeed with most of our populations already living in urban areas, the need for a sustainable urban development is greater than ever. With respect to education, nature can play a unique role providing benefits at the individual, community and global level.

2 Socio-economic and Educational Challenges in Contemporary Cities

Global challenges unfold at the local and city level, directly impacting on citizens' well-being. Understanding the challenges which exist across spatial and temporal scales represents a key step towards building city resilience. Evidence demonstrates the close dependence of our cities on nature, whether it be in the resources we consume, the soils on which we grow our food, the purification of the air we breathe and the water we drink. There is therefore a need to integrate nature not only in a physical sense, by ensuring access to ecosystem services, but also theoretically to provide a comprehensive and sustainable approach to education.

2.1 Citizen Wellbeing

Awareness of the contemporary challenges faced by individuals is a first step towards developing healthy and sustainable cities, and understanding how education can play a role in supporting personal wellbeing. In cities across the world,

economic growth and improved access to products and services, including technology, mobility and information, demonstrate some of the successes of global development. However, many of these benefits have brought costs to the environment and society (Wheeler and Beatley 2014).

The mechanization of industries and transport systems has led to congestion and noise pollution as well as contamination of waterways, oceans and the atmosphere. The WHO estimates that 1 million healthy life years are lost every year from exposure to noise pollution from traffic in western Europe alone (EEA 2014). The nature of work, as well as working and living environments, have led to increasingly sedentary lifestyles (Kahlmeier et al. 2015). The industrialization of food systems, alongside the consumption of foods high in fat and sugar, has also increased the risks of obesity as well as respiratory and cardiovascular disease (Popkin et al. 2012). At the same time, poor mental health has emerged as a social pressure equally significant to physical health but much less well understood (Wittchen and Jacobi 2005). In socio-economic terms, these challenges have far reaching consequences, including indirectly threatening populations with unemployment, increasing levels of public and private debt, as well increases in wealth inequalities not just between countries but also within them (Oxfam International 2017). Furthermore, factors which go beyond wealth, including age, ethnicity, and gender, remain determinants of health and social outcomes (Mutafoglu et al. 2017).

2.2 The Responsibility of Cities

Cities play a crucial role in driving environmental change at the global level. Society's ecological footprint is well in excess of the planet's bio-capacity and continues to grow (Wackernagel and Rees 1996). Resource extraction and pollution threaten a number of key planetary boundaries (Rockström et al. 2009). The unprecedented growth of cities in terms of their size, number, and levels of consumption over the last century means that urban areas are central to driving these pressures. For example, one study estimated that people in the City of London, the capital's business and financial district, had a per capita carbon footprint 25% higher than the average for the UK. In this context, it is increasingly being acknowledged that it is the dense, high consumption, and wasteful conurbations in which most of the world's growing population lives, that drive environmental degradation and at the same time represent the most appropriate scale for generating solutions (Satterthwaite 2009). The growing impacts of cities on the global scale suggests the need for action starting from urban populations and policies, emphasizing the responsibility of cities in delivering solutions (Grimm et al. 2008).

2.3 Future Demography and Economic Development

Growing populations and extended life expectancies represent successes in medicine and development but also bring about socio-economic challenges. Competition over resources, employment opportunities and pressures on public services, have implications for society and the economy, as well as on approaches to education. Progress in medical science has extended life expectancy but has also created dependencies on health care, pensions systems, care for the elderly, and pharmaceuticals. Therefore, being able to live longer comes with an associated economic and social burden. In Europe, projections suggest that life expectancy at birth will increase by 7.1 years from 77.7 years in 2013 to 84.8 years in 2060. Additionally, over the same period old age dependency is anticipated to change from four working age people for every person over 65 to two working age persons (European Commission 2015). Moreover, there are uncertainties concerning how some disabling conditions, including musculoskeletal diseases and dementia, will develop in the future, and how these changes will be reflected in demand for public health provisions. Many governments are under pressure to extend working lifetimes and maximize the productivity of individuals in order to ensure that the economy is able to support the expected costs of care (European Commission 2015). This presents challenges for education. To support economic development in an ageing society, education is viewed as tool which will be present throughout our lifetimes, not just in the early years.

Analysing the role of nature in the context of education hence serves several purposes. Firstly, we can examine the benefits which nature based education can bring to individuals, secondly, the role of nature in cities can be examined at the community level and finally, how both of these aspects feedback into national and global development objectives, such as those defined by the Post 2015 agenda. In the context of the United Nations Sustainable Development Goals, the need for sustainable urban development is a core facet. Some of the relevant goals are identified in Table 1.

2.4 Solutions—Evidence and Practice Demonstrating the Multiple Benefits of Nature Based Education

Pressures for economic performance and rapid industrialization have arguably seen nature take a back seat in education priorities. However, a growing evidence base demonstrates that society is highly dependent on nature across multiple pathways which are just as relevant to urban environments as rural ones. Additionally, there is a growing demand for Education for Sustainability, i.e. integrating the objectives of sustainable development into education systems (Annan-Diab and Molinari 2017). Hence, using nature in education becomes a tool to sustainably exploit those dependencies and heighten our understanding of them. Likewise, improving

Table 1 Goal 11. Make cities and human settlements inclusive, safe, resilient and sustainable

11.3 By 2030, enhance inclusive and sustainable urbanization and capacity for participatory, integrated and sustainable human settlement planning and management in all countries
11.4 Strengthen efforts to protect and safeguard the world's cultural and natural heritage
11.6 By 2030, reduce the adverse per capita environmental impact of cities, including by paying special attention to air quality and municipal and other waste management
11.7 By 2030, provide universal access to safe, inclusive and accessible, green and public spaces, in particular for women and children, older persons and persons with disabilities
11.a Support positive economic, social and environmental links between urban, peri-urban and rural areas by strengthening national and regional development planning
11.b By 2020, substantially increase the number of cities and human settlements adopting and implementing integrated policies and plans towards inclusion, resource efficiency, mitigation and adaptation to climate change, resilience to disasters, and develop and implement, in line with the Sendai Framework for Disaster Risk Reduction 2015–2030, holistic disaster risk management at all levels. (United Nations 2016)

Table 2 Potential benefits of nature based education

Individual	Community	Planet
Physical wellbeing Regular exercise Healthy diets Reduce exposure to air pollution *Mental wellbeing* Reduce stress Improved mood Sense of belonging	Reduce public expenditure costs on health care Reduce public expenditure costs on education Increase labour productivity Improve social cohesion Improve the aesthetics of urban areas	Education for Sustainability Lower carbon footprint at planetary level Sustainable food purchases Behavioural change towards sustainable mobility choices

wellbeing can accelerate learning and our capabilities supporting economic and social development more widely (Table 2).

2.5 Daily Mental Health Benefits Exposure to Nature

Nature's physical presence in working and living environments has been shown to deliver benefits for physical and mental wellbeing (ten Brink et al. 2016). Spending time in natural spaces serves dual preventative and therapeutic purposes (WHO 2017): firstly, in helping to maintain a good level of well-being, and secondly in providing benefits for people recovering from illness or stress. Access to nature in cities can reduce costs (e.g. reducing health care expenditure) or provide alternative cost-effective solutions (e.g. ambulatory care compared to hospitalisation). Regular exposure to nature has a positive effect on mood, concentration, self-discipline and physiological stress. Evidence shows that people living in a greener environment

experienced fewer health problems and scored their health more positively compared to people living in less green areas. Moreover, some evidence exist demonstrating that being in natural environments can lower blood pressure, pulse, and reduce cortisol levels (Gascon et al. 2015). Finally, being physically active in green areas provides not only physical health benefits but also positive effects on mental health. Green space can encourage regular exercise both in terms of frequency and the duration of activities (Richardson et al. 2013).

Moved by Nature, Kuopio Finland "Moved by Nature" in Finland was launched to promote collaboration between nature and health sectors to allow vulnerable groups to benefit from access to physical activity in natural spaces, delivering tangible results in physical condition and self-esteem.

Through physical activities and active learning the project succeeded in motivating inactive overweight men at risk of type-2 diabetes to engage in outdoor activities and adopt healthier diets. The European Social Fund (ESF) funded 75% of the EUR 348,000 cost of the Moved by Nature project. The remaining funds were drawn from local social groups and municipal authorities, such as the City of Lieska who ran a similar programme with migrants and the long term unemployed (Schweitzer et al. 2016).

2.6 Children—Nature Based Recreation and Cognitive Development

Green areas in urban environments present multiple benefits during childhood development. The presence of nature and its accessibility increase the time spent outdoors which is found to largely contribute to the development of children's recreational and physical activity, as well as health and concentration. Evidence shows that exposure to natural environments can lead to higher self-esteem and emotion regulation in children, therefore resulting in improved social behaviour. Moreover, concentration levels have been shown to be higher after being in contact with nature, indicating a clear beneficial effect of such exposure in terms of learning abilities (Laaksoharju et al. 2012). Children are also more physically active due to the incentives provided by natural areas to engage in outdoor activities (Janssen and Rosu 2015). This creates positive effects on health not only in terms of fitness but also as regards the emotions generated by being exposed to nature during activities of this kind, something which is generally underestimated (ten Brink et al. 2016).

On the other hand, a lack of access to green areas presents potential challenges. Within this context, the term "nature deficit disorder" has developed, emphasizing, as defined by Louv (2008), the "human costs of alienation from nature". Such costs

relate to the negative impacts associated to a lack of exposure to natural areas which include, concentration difficulties, diminished use of senses and higher rates of physical and emotional illness (Lloyd and Gray 2014). One way in which nature accessibility to children may be challenged derives from the potential lack of supervision in the outdoor environments. Nevertheless, the introduction of supervised outdoor activities into school systems represents an effective solution to the issue (Lloyd and Gray 2014). Moreover, evidence shows that green spaces in school facilities represent an effective way of reaping the benefits of natural environments on children's development (ten Brink et al. 2016). Forest Kindergartens in Finland are clear examples of such a trend which is now developing in many other countries. Finland's education system in pre-schools is largely based outdoors and is considered one of the best globally (Woodland Adventurers 2014; Robinson 2012).

2.7 Nature Based Rehabilitation

A growing number of studies indicate that nature and green areas can have a restorative function and positively impact people's health and well-being (ten Brink et al. 2016). In particular, exposure to green spaces has been shown to contribute to stress reduction (Tenngart Ivarsson 2011). Evidence shows that rehabilitation and recuperation processes can be enhanced by their proximity to green areas (ten Brink et al. 2016). Such findings have led to the development of nature-based rehabilitation practices as an intervention for stress-related disorders. Contrarily to ordinary rehabilitation therapies, practices of this kind take place in selected gardens or natural environments and are led by a multidisciplinary rehabilitation team and personnel with nature-related competences (Bernhardsson et al. 2016).

Alnarp Rehabilitation Garden, Sweden Alnarp rehabilitation Garden was designed in 2011 on the Swedish University of Agricultural Sciences campus. The aim was to introduce a new kind of therapy which integrated the positive effects of nature on rehabilitation with traditional occupational therapy, by bringing together theories on horticultural therapy and restorative environments (Tenngart Ivarsson 2011). The garden is subdivided, each section designed with properties for restoration and supportive environments to meet the needs of the participants during the rehabilitation process. At Alnarp, patients suffering from severe stress and/or mild to moderate depression have been shown to reduce their reliance on conventional health care provisions when participating in NBR. One year after rehabilitation, the costs for primary care had dropped by 28% for the intervention group in Alnarp (8% for controls receiving rehabilitation as usual), and in terms of days spent in hospital, they had fallen by 64% (Schweitzer et al. 2016).

2.8 *Economic and Employment Benefits*

The health and education sectors play a crucial role in delivering a range of services to society and the economy. In Europe, many countries face fiscal uncertainty in the provision of public services. Health care expenditures already represent 15% of public expenditure (ten Brink et al. 2016). In the future, it is likely that demographic change, including ageing populations, could place further stress on the health care systems (Rechel et al. 2009). Nature-based solutions can help to alleviate budgetary pressures on health care provision, and deliver health and social benefits. For example, protected areas have been considered to be "health hubs" due to the range of health and educational activities which are increasingly taking place in these natural areas (ten Brink et al. 2016). WHO Europe identified the need to include physical activities and health treatments taking place outside of hospitals, as well as establishing clearer links between health and social services (Rechel et al. 2009).

In addition to helping to alleviate budgetary pressures, the natural environment can offer opportunities for employment, volunteering and skills development. Nature-based employment allow individuals to be economically active while benefitting from the positive effects of the natural environments where the activity takes place (ten Brink et al. 2016). Nature volunteering focuses on practical environmental and conservation tasks (Volunteer Development Scotland 2006) and, similarly to other forms of volunteering, can generate social and community benefits. Volunteering programs based in natural areas such as parks, protected areas and gardens are found to enable people to engage with one another and build a stronger sense of community, trust and caring (ten Brink et al. 2016). Interactions with the natural environment can lead to an enhanced sense of belonging and create opportunities for social networking (New Economics Foundation 2012). This allows individuals coming from different backgrounds to share the same experience. Literature indicates that the diversity of volunteers who engage in nature-based activities contribute to increasing social cohesion by creating the context and opportunities to build trust and reciprocity (Ockenden 2007).

The Social Forest, Barcelona Social Forest is a Catalan organisation, based in the Collserola Park in Barcelona, dedicated to forestry management. It presents both a social and professional dimension for young people at risk of social exclusion, with the aim of tackling unemployment and enhancing social inclusion. The Social Forest provides training in forestry services and promotes sustainable forest management, forest fire prevention, as well as the use of renewable energy (ten Brink et al. 2016).

2.9 Biophilia Contributions to Ecological Stewardship

The biological need of humans to connect with nature is described through the term 'biophilia'. The concept has largely developed in the scientific, design, and architectural arenas, stressing the beneficial effects that can be derived from such relations (Terrapin Bright Green 2012). It is argued that connection to nature provides the necessary basis to promote eco-literacy and children's understanding of environmental issues, therefore encouraging environmentally friendly behaviour (Lloyd and Gray 2014). In other words, being in contact with and appreciating nature can support ecological stewardship, and might be more effective at doing so than communicating risks associated with environmental degradation (Mayer et al. 2009). Conversely, a lack of such connectedness could undermine the importance of nature conservation in the future (Bragg et al. 2013). Consequently, access to nature, active engagement with nature based activities from a young age, and demonstrated interest in nature from parents and teachers can become determinants of sustainability (Chawla and Flanders Cushing 2007; Wells and Lekies 2006).

The role which education can play in supporting sustainability is emphasised in SDG 4.7: "By 2030, ensure that all learners acquire the knowledge and skills needed to promote sustainable development, including, among others, through education for sustainable development and sustainable lifestyles, human rights, gender equality, promotion of a culture of peace and non-violence, global citizenship and appreciation of cultural diversity and of culture's contribution to sustainable development" (United Nations 2016). Outdoor education represents a powerful tool to deliver this goal through the multiple positive effects that nature can have on learning and, at the same time, those that outdoor education can have on the social, economic and environmental aspects of urban life.

Zmeeva Dupka Eco-Trail: Engaging Children in Nature The eco-trail in Zmeeva Dupka, Bulgaria, a Natura 2000 site, is a project led by a local child care charity. The trail was constructed with the contribution of SOS Children's Village Tyrvana as well as local carpenters to improve the accessibility to the site and provide opportunities for learning and physical activities. The eco-trail has significantly increased the popularity of the site which is now one of the most frequented nature destinations of the region. By making the site safer and more accessible, the eco-trail has promoted recreation especially among young people while reducing the negative impacts of an exploitive use of nature, including deterring illegal hunting and dumping. This way, the project has enabled different social groups to engage in nature, while keeping the natural area protected (Schweitzer et al. 2016).

2.10 Urban Agriculture, Reconnecting Rural Urban Divides

In the context of food systems, as well as other elements of the bio-economy, urban populations are typically reliant on activities located outside city limits. The physical separation between agricultural production and the end consumer can be problematic for sustainable development for a number of reasons. Firstly, the ecological footprint of food travelling large distances can be significant in terms of emissions and resource use. Secondly, the production of food degrades soils locally, particularly where biomass waste streams are not returned. This creates dependencies on artificial fertilizers with further impacts on local environments. The Food and Agriculture Organisation of the United Nations (FAO) estimate that one quarter of land across the globe is degraded (FAO 2011). Thirdly, urban consumers are sociologically disconnected from the production process. Arguably, this can drive a misunderstanding of the value of food and of the land where it was produced. In an urban environment, the cultural significance of food might instead be shaped by marketing and the retail sector. This is reflected in the demand for cheap meat and dairy products, or fruit and vegetables which are exotic or out of season locally, as well as driving food waste—which accounts for around one third of all food produced (FAO 2012; Gustavsson et al. 2011).

Nature based education can help to increase the sustainability of our food systems. Foster (2000) coined the term 'metabolic rift' in order to critique the divide between nature and human consumption, particularly in relation to urban environments. Urban gardening and farming simultaneously provide an opportunity for the local provision of food and a form of nature based education which can help to bridge this physical and ideological divide. Although in terms of yield the scale of production from urban farming remains low, for some people it remains a major source of nutrition and income (McGranahan et al. 2005).

Today, there is a growing demand for local food which is made without degrading the environment. Short food supply chains, and initiatives such as Community Supported Agriculture (CSA), provide opportunities for citizens to access local products via fewer intermediaries, as well as supporting fairer trading relations with farmers. In Detroit, following the financial crises of 2008, large areas of land were occupied for urban farming and gardening helping to preserve the livelihoods of whole communities in a city which was economically bankrupt. Across the globe, allotments and urban agricultural holdings remain relevant through teaching the real value of food and building resilience by supplementing access to food from convetional markets (McClintock 2010).

TERRA Community Supported Agriculture—Luxembourg City, Luxembourg Transition and Education for a Resilient and Regenerative Agriculture (TERRA) provides an example of urban agriculture and nature based education from Luxembourg. TERRA use permaculture and community supported agriculture (CSA) as a food system to support 150 families with organic food from 1.5 hectares of land close to the centre of Luxembourg City. TERRA operates as a cooperative; its members pay a membership fee in advance (EUR 18–24 per week) entitling them to a share of the harvest. This form of risk sharing means that the farm is not dependent on agricultural subsidies or bank loans. The farm employs three people full-time and is supported by a network of volunteers who benefit from professional training on permaculture techniques (Schweitzer et al. 2016).

3 Instruments—Action for Sustainable Cities

3.1 City Plans and Strategies

The resilience of cities and urban planning are closely related. Cities increasingly integrate the multiple values of nature into their plans, taking into consideration aspects which go beyond economic performance (Shen et al. 2011). City strategies can represent tools for preserving biodiversity, green infrastructure and making these both accessible to citizens. Urban initiatives such as tree-planting, developing new parks or greening brownfield sites, can open up new opportunities for nature based activities (Secretariat of the Convention on Biological Diversity 2012). Barcelona's Biodiversity and Green Infrastructure 2020 plan represents a relevant example of the city's commitments to the preservation and enhancement of their natural heritage. The plan, which builds on the city's Agenda 21, has the signatory

support of over 800 local companies and organisations, and provides the overarching basis for a number of projects in the city (Ayutament de Barcelona 2013). One initiative "Apropa't als Parcs" (Come to the Park) aims at connecting the city's schools with their local park. It provides resources to schools to allow them to carry out activities in green spaces based on the understanding that parks should be redefined as educational spaces (Ayutament de Barcelona 2011).

3.2 Measuring Progress, Indicators for Cities

Urban data can support the monitoring and evaluation of sustainable development. The central role which data from cities will play in achieving the Sustainable Development Goals was acknowledged through the United Nations Conference on Housing and Sustainable Urban Development, Habitat III (UN-Habitat 2016). The development and identification of suitable urban sustainability indicators is a complex task. When using statistical tools such as benchmarking or composite indices there is a risk of simplifying the multiplicity of a given city's needs (Shen et al. 2011). Having said this, efforts to integrate environmental and social variables into urban accounting could help to foster urban environments which facilitate citizen wellbeing.

The Arcadis Sustainable Cities Index represents an example of how the environmental, social and economic dimensions of a city can be measured and compared. It ranks 100 cities based on 32 indicators. Amongst the seven environmental sustainability indices, green space provides one of the measures of performance. Zurich, Stockholm, Geneva and Vienna, were the best performing cities across all environmental factors (Arcadis 2016).

Such measures can incentivise cities to improve access to nature and feedback into urban development plans. These can support nature based activities and the development of healthy urban environments more widely.

3.3 Urban Design

Specific actions can be undertaken within urban design to develop infrastructure with the aim of making cities healthier and more sustainable.

As cities become more densely populated, land uses changes can make green space sparse and diminish access to nature. Urban design presents opportunities to reduce this risk through re-establishing both physical and emotional connection to nature via 'biophilic interventions' (Terrapin Bright Green 2015). As we better understand the value of nature in urban design, infrastructure including street trees,

pocket parks, moss walls and green corridors are increasingly visible in cities (Browining et al. 2014).

Bosco Verticale—Milan, Italy Completed in 2014 in the Porta Nuova district of Milan, the Bosco Verticale (Vertical Forest) provides an example of contemporary design which aims to integrate the multiple values of nature from the onset. The project consists of two large towers which have dense trees and vegetation planted on all of their facades. The two buildings can hold over 400 large and medium sized trees, 11,000 ground cover plants and 5000 plants—roughly equivalent to 2.5 acres of forest (European Commission 2015b).

Le Parc des Hautes Bruyéres—Villejuif, France Le Parc Départemental des Hautes-Bruyères is a former industrial zone in Villejuif in the south of Paris, which has been converted into a public green space. The park contains recreational areas for children, sport pitches, educational spaces as well as a medicinal garden and a silence garden. The contours of the park were deliberately designed in order to act as an aural buffer to a nearby motorway. The development of the park has since led to a reduction in noise levels of up to 20 dB in the area and promoted outdoor physical and educational activities among local residents (Schweitzer et al. 2016).

3.4 Public Sector and Curriculum

Within public education systems there are opportunities to harness the potential benefits of nature based education. Implementing and upscaling the use of nature based education in the context of national curricula does not necessitate dramatic changes in approaches to education, but rather could be complimentary to conventional teaching.

Schools can play a role in physically integrating green infrastructure into children's learning environments. In the United Kingdom, consecutive governments have been criticized for allowing local authorities to sell school land which was previously reserved for sports and recreation. Between 1979 and 2008, over 10,000 playing fields were sold by schools in the UK (Department for Culture Media and Sport 2008). This could reflect a lack of funding for public education but also the undervaluing of green infrastructure in the context of schools. There are many cases of deliberate attempts to use green spaces in schools and other institutionalised settings. Examples include gardening and physcial activities. In some cases these initiatives aim to embed nature based learning as part of the normal curricula (WHO 2017).

Woodland Health for Youth, Plymouth, United Kingdom The Woodland Health for Youth initative is a partnership between Plymouth City Council, several local educations institutions and health care providers. The aim of the project is to "integrate whole-school health promotion and education poliy though children's learning outside the classroom in nature environments". The proejct evaluated the benefits of carrying out normal lessons for primary school students in a local wooded area. The study measured levels of physical activity, body mass index (BMI) and qulitative data from participants and organisers. Over a three year period the study showed that all students had reduced their BMI (Aronsson et al. 2014).

Caritas Neighbourhood Garden, Vienna The Neighbourhood Garden project comprises three gardens at social facilities of Caritas in Vienna, Austria. The project, started in 2013, aims at providing a common space for social interactions for people facing different health and social challenges. The residents of the care homes involved in the project are elderly people, disabled people and young refugees who engage with the volunteers in gardening and other related activities. At the start of the cooperative gardening season participants get to know each other and make plans for the garden. Such activities, and the exposure to natural gardens in general, have positive effects on their well-being and enable them to learn from each other and share their experiences, opinions and visions (ten Brink et al. 2016).

Further consideration could be given to the material covered in curricula in contemporary teaching. An emphasis on standardized testing and academic ability in national curricula arguably focus on economic objectives rather than more holistic ones linked to personal and socio-cultural development. Many contemporary education systems focus on preparing children for economic activity and employment. For example, the European Union's Lisbon Strategy set the following goal for the year 2010: "*become the most competitive and dynamic knowledge-based economy in the world capable of sustainable economic growth with more and better jobs and greater social cohesion"* (Lundvall and Rodrigues 2002). In this context, it is foreseeable that education becomes an instrument for driving economic growth or development in strategic sectors. However, Ken Robinson argues that our understanding of education is based on the earliest forms of public education formed in the enlightenment. Excessive emphasis on academic ability and standardized testing can act to reduce divergent and creative thinking (Robinson 2012).

3.5 *Private Sector, Finance and Investment*

The private sector can play a role in implementing nature based education, in particular in supporting financing of infrastructure and services. The impacts of increasing private sector participation in the context of providing what might previously have been considered to be public services have been analysed in detail in a range of sectors including health care, water provision, waste management, and transport (Heynen et al. 2006). Much less has been said about the role of the private sector in engaging in green space in cities and natural environments, or indeed what impacts this can have on education.

Attracting private investment in green infrastructure can help to overcome financial barriers to ensuring public access to nature as well as opportunities for nature based education. Yet, private control of nature risks reducing public access or might lead to redevelopment for alternative uses (Jacobs 1961). These challenges become acute in urban environments, where natural spaces are scarce and contested.

Blending financing or privatising green spaces has in some cases been demonstrated to allow for the preservation of nature conservation areas. Indeed, the presence of the private sector is common in protected areas across the globe, and continues to provide necessary services (management, transport, utilities, tourism etc.) as well as employment opportunities.

In recent years, there has been growth in analysis of Privately Owned Public Spaces (Pops), which reflect a blurring of the definitions of publicly accessible and privately owned open and green spaces in contemporary cities. In the United Kingdom, one report suggested that 45% of local authorities were considering either selling their green spaces or transferring their management to third parties (Heritage Lottery Fund 2014). In the case of Pops it has been suggested that private ownership could lead to restrictions in how the space can be used, however their long term impacts are unclear.

Secovlje Salina Nature Park and Lepa Vida Spa, Slovenia The protected area Salina Nature Park is a protected area of salt flats and is managed via a public private partnership. The Sečovlje Salina Nature Park is the first state-designated protected area in Slovenia. Management of the park and the parks operating salt pans are run by a subsidiary of the Slovenian telecoms company Mobitel. Mobitel benefit from PR and marketing linked to the park, as well as revenues from 50,000 annual visitors. Mobitel are obliged to contribute to the up-keep of the protected area. According to the concession agreement, all of the assets and investments in the park's infrastructure remain property of the Republic of Slovenia. The park remains an important nesting site for 288 species of migratory birds (ten Brink et al. 2016).

3.6 Citizen and Bottom up Action

As well as benefitting from natural spaces in cities, citizens also play a central role in their up-keep and maintenance, both physically, politically and financially. Arguably, citizens recognise the value of natural areas for their wellbeing and hence actively invest in preserving them. Grass roots activities to preserve nature in urban environments can be particularly powerful where public finances are restricted or where there are competing interests over resources. For example, preventing the conversion of natural areas in cities to alternative land uses is a common subject for political activism and protest in contemporary cities. Furthermore, large public parks commonly act as nuclei for a range of social movements. Protests in Taksim Gezi Park in Turkey is a case example in this respect.

As well as political action to retain access to parks and other public spaces, citizens are also active in the physical and financial upkeep of parks. The aforementioned study of the threats to UK parks, notes that friends of parks and user groups have growing membership, and that such groups raise an estimated GBP 30 million per year (Heritage Lottery Fund 2014). In Munich, Germany, "guerrilla gardening", gardening on public or unused land, has been legalised on a permit system which is mediate by the NGO Green City. Guerrilla gardeners are allowed to garden where they like but within the terms of the contract and if they don't use the land responsibly, their permits can be repealed.

Collectively, these citizen initiatives can help to maintain public access, improve the quality of existing spaces, and allow for educational and other nature based activities.

Berlin Tempelhof citizen referendum Tempelhofer Feld (Tempelhof Field) is the former site of the German capital's airport. The airport has been closed since November 2008 and in May 2010 it was opened as a 300 ha public park, with investments from the city of €60 million to 2017. This plan included 80% of its space being conserved as a grassland habitat for a number of redlisted birds, including the skylark, the red backed shrike, tawny pipit and the wheatear (ten Brink et al. 2016). In 2011, however the government presented plans for 25% of the Tempelhofer Feld to go to property development. The plans received widespread opposition from the citizens of Berlin. A petition entitled *100% Tempelhofer Feld initiative* gathered 185,000 signatures forcing the city to hold a referendum on whether the development should proceed. 64.3% of voters rejected the development proposal, consequently preserving the site as a public park for recreation (Fahey 2015).

3.7 Citizen Science—City Level Sustainability

Urban populations can contribute directly to research through participation in citizen science. These activities can then help to support the resilience of a city and nature conservation. Additionally, the research and data drawn from citizen science can provide the material to educate future generations.

Public participation in scientific research can be witnessed in many cities. Common activities include birdwatching, butterfly counts, climatology, as well as pollution observations (such as for marine litter). Collective and crowd sourced data gathered by citizens provide reliable and usable sources for academics feeding directly into ongoing research (McKinley et al. 2017). Internet and smartphone applications increasingly facilitate citizen science activities, guiding participants, reducing time lags in processing data and automatically geo-locating observations. Additionally, citizen science often necessitates active engagement in one's natural environment which will bring further benefits to that citizen as outlined in the rest of this chapter.

Great Pollinator Project, New York City The Great Pollinator Project was an initiative run between 2007 and 2010 in order to help conserve pollinator habitats of bees and other pollinators in the area of New York City. The project was initiated by the American Museum of Natural History and the New York City Department for Parks and Recreation's Green Belt Nature Plant Centre. The project was reliant on data from volunteer Bee Watchers. Over four summers 125 volunteers submitted almost 1500 observations (Great Pollinator Project 2014). A survey of participants attempted to find out the motivations of bee watchers. The most common motivation listed was to learn about bees, this was followed by contributing to scientific research and attracting more bees to their back gardens (Domroese and Johnson 2017).

4 Conclusions

This chapter identifies the contemporary challenges faced by urban populations in European cities, and some of the opportunities which exist in nature based education. Nature based education is understood in three respects, firstly in terms of environmental education as a topic within public and wider education systems, secondly the deliberate inclusion of natural environments in educational activities, and thirdly the wider integration of nature including green infrastructure in the built environment to support the passive exposure to nature in urban populations. Many of the stresses, on the physical and mental wellbeing of individuals in addition to community and planetary based challenges, can be linked to failures in sustainable

urban development, and in many cases an absence or degradation of the natural environment. The need for sustainable and resilient cities is central to the objectives of the SDGs. Drawing on European research into the multiple benefits of nature, we identify that nature can bring about individual, community and planetary level solutions, which can be mutually reinforcing. Benefits identified include: preventative health care and heightened wellbeing; improved cognitive and social development of children; nature based rehabilitation; socio-economic and employment opportunities; contributions to sustainable production and consumption via biophilia. Opportunities to implement nature based education exist at a range of scales. At a city level, strategies, design and data can help the development of urban environments that ensure access to nature. Additionally, nature based education can be integrated within public education curricula. Finance and political support for nature based education, can be drawn from a range of sources including the private sector and bottom up initiatives. In summary, nature based education should play an increasingly central role in the ambitions of cities in Europe and beyond.

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Co-creation for Sustainability as a Societal Learning Journey

Petra Kuenkel and Alina Gruen

Abstract Lifelong learning underpins economic, ecological, and social wellbeing, and provides the foundation for citizens to shape the future of societies collectively. The 2030 Agenda for Sustainable Development, 'Transforming our World', outlines a sustainable future in various dimensions. Cities are an example of learning communities that can benefit from looking at lifelong learning not only as an individual capacity, but the capacity of a collective of actors. This chapter explores the relationship between lifelong individual and collective learning with particular focus on learning in multi-stakeholder collaboration that enhances systemic change towards sustainability. It argues that new competencies are needed, such as collaboration, trust-building, genuine dialogue, and the ability to see learning as an integral element of working towards more sustainable societies. The last decade has seen a proliferation of collaboration efforts for sustainability initiatives in multi-stakeholder settings, which can be seen as one way of advancing both individual and collective learning. More structured methodological approaches to collective learning are needed. The chapter suggests one such methodology—the *Collective Leadership Compass*—a guiding tool for transformational change processes in multi-stakeholder collaboration. Derived from 20 years of practice in complex multi-stakeholder settings around system's change for sustainability as well as scientific exploration into living systems theory, the compass functions as diagnosis tool and a process methodology. It enhances the collective learning capacity of a system of diverse actors engaged in societal change initiatives. The application suggests that multi-stakeholder collaboration for sustainability issues is an interesting laboratory for understanding what accelerates collective learning as a core element of the long-term flourishing of human societies and the planet as a whole. Further research could include exploring how institutional actors could make use of such methodologies in societal change for sustainability.

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1 Introduction

Education and lifelong learning are key to the long-term flourishing of human societies and to the planet that hosts them. Education underpins economic, ecological, and social wellbeing, and provides the foundation for growth, evolution, democracy, and the full participation of citizens in exercising their civil rights. Ongoing learning throughout life offers learners psychological, intellectual, and emotional tools leading to greater life satisfaction (Hof 2009), as well as providing values to individuals that support responsible change towards sustainability (Sterling and Huckle 2014). In the year 2015, the 2030 Agenda for Sustainable Development, 'Transforming our World', has been adopted at the United Nations (UN) level. It outlines a sustainable future in various dimensions, e.g. food security, peace, security, safe and healthy environments (United Nations 2016). Cities are one element of safe and healthy environments and are an example of various voluntary and non-voluntary learning communities that can benefit from looking at lifelong learning not only as an individual capacity, but the capacity of a collective of actors (Kuenkel 2016).

This chapter explores the relationship between lifelong individual and collective learning with particular focus on learning in multi-stakeholder collaboration that enhances systemic change towards sustainability in socio-ecological systems. Transformation to sustainability is here understood as a change in human social and economic behavior that ensures livable conditions for nature and humankind. It has been widely acknowledged that the impact of humanly induced change on the Earth has become so profound that this can potentially endanger the biosphere balance (Steffens et al. 2007). Hence learning for sustainability, individually and collectively, becomes increasingly important. New competencies are needed, such as collaboration, trust-building, genuine dialogue, and the ability to see learning as an integral element of working towards a society that better balances the interests of the individual with the interests of the planet as a whole. Lifelong learning and agency for a better world are intrinsically connected. Shaping future together in response to larger goals and the common good helps people grow their potential beyond their limitations. When people feel they are part of a collaborative change endeavour and a meaning-making contribution, they strengthen their learning capacity in relation to the task or challenges ahead.

2 Lifelong Learning as an Activity not Only of Individuals, but also Collectives

Learning does not take place in isolation. It is a collective phenomenon and a socially constructed activity of meaning-making from experience and information by sharing beliefs, desires and intentions that engage cooperative behavior (Searle 1995). It is an ongoing interrelated interaction between people by "[…] listening, expression, decision-making, evaluation, organization, connection, and vision […]" (Lévy 1997, p. 70). The thought processes of individuals are influenced by the collective thought processes in groups, organisations, and society (Laat and Simons 2002). Hence, the role of collaboration as a way of accelerating learning capacity needs to move to the centre of attention. This does not only apply to the social sphere. Corporations have seen a significant increase of attention to learning as a collaborative activity, in the form of inner- and inter-organizational cooperation (Vyas et al. 1995) to overcome the fast-paced and increasingly complex economic development. Technological advances and new media have spurred global communication and information networks so that new forms of collaboration became possible. To be able to operate successfully in what has been termed the Volatility, Uncertainty, Complexity, Ambiguity (VUCA) world both individual actors and organizations need to foster collaboration, networking and innovative thinking (Polman 2014). Working together with different actors in a creative and solution-oriented manner and learning from each other is increasingly seen as an advantage for all parties involved.

Additionally, the radical changes in technology make it possible for people to participate in global communications, consume and share information from a variety of sources. People can critically observe and react to their environment evaluating events, institutions, persons, products or services. Moreover, undeniably unsustainable megatrends (Horx 2011) such as climate change and biodiversity loss have moved into the awareness of many more people. Even though the shift in consciousness has not yet been sufficiently translated into more responsible collective action, it is clear that long-term sustainability requires an acceleration of collective learning structures. With this background, the importance of education, and lifelong learning as a collaborative capacity moves to the foreground. This suggests a conceptual shift in the approach to learning: from the focus on individuals and their skills and capacity to understanding learning as a collaborative feature of collectives of actors (Lévy 1997). Exemplary shifts are suggested in Table 1.

3 The Route to Sustainability: A Collective Learning Journey

The author Laloux (2014) argues that fundamental change in societies requires both the evolution of individual consciousness and collective collaborative learning settings. A widely acknowledged approach to learning is Senge's (1990) concept of

Table 1 The shift in learning as a result of complex collaborative change (own representation, 2017)

From: Learning is seen as the capacity of the individual with the purpose of maintaining and expanding personal and professional growth	To: Learning is seen as the capacity of a collective with the purpose of sustainability transformation, and enrichment of the common good
Silo-approaches and competitive thinking dominate	Collaboration and co-opetition become the norm
Learning takes place in hierarchical contexts with learner and conveyer of knowledge clearly distinguished where	Collective learning takes place in non-hierarchical and co-operation contexts. Actors have multiple forms of expertise
Learning achievements are driven by the urge to ensure advantages; the common good is not necessarily the focus of learning	Learning is seen as a continuous individual and collective process to improve the contribution to the common good
Dialogue and co-operation are side-issues for learning	Outcome-oriented dialogue and future-oriented collective action are key factors of for the collective learning capacity

"personal mastery". He emphasizes that our past learning approach has been one of fragmentation, of assuming that the knowledge of the pieces is enough to create an integral whole. Yet, his notion of "learning organizations" aims at re-creating a learning approach which allows the whole to become visible in a process of continuous growth (ibid., 1990, p. 14). With personal mastery Senge refers to the development of life and leadership proficiency that includes the development of the whole person in the societal context. He states: "Real learning gets to the heart of what it means to be human, through learning we re-create ourselves. […] we re-perceive the world and our relationship to it. Through learning we extend our capacity to create, to be part of the generative process of life" (Senge 1990, p. 14). In that way he assumes that personal mastery is not a state to be achieved, something one owns after disciplined effort, but a continuous process, a discipline, which always needs attention (Senge 1990). The perception of reality then, becomes the perception of multiple realities, various possibilities and more than the one right way ahead. Looking at sustainability transformation from the perspective of a discipline of "mastery" sheds a new light on understanding it not only as an individual, but also a collective learning journey that requires continuous attention.

The last decade has seen a proliferation of collaboration efforts for sustainability initiatives in multi-stakeholder settings (Kuenkel and Aitken 2015). Increasingly governments embark on consultation processes with various stakeholders, civil society organizations get into partnership with business to increase their impact, or many different stakeholders join together to partner for certain issues of common concern (Kuenkel 2016). Collaboration between different societal sectors has moved onto the agenda of most institutions (Kuenkel 2015). Multi-stakeholder settings can be seen as laboratories for leading societal change collectively, and for finding new ways of continuous collective learning processes. Hence, the above explored approaches are not only essential for lifelong learning, but are also crucial

for collective learning in sustainability transformation initiatives that aim at long-term solutions in cities and local societies to create a healthy environment and a sustainable urban future.

4 The Entry Point of Lifelong Learning: Leveraging Collective Intelligence

Learning in multi-stakeholder settings rests on the assumption that diversity in experience, expertise and perspectives benefits better solution. Collective intelligence emerges in structured discourses that acknowledge disagreement and different opinions. However, the more people see themselves as separated and fragmented from the capacity to shape future collectively the more they feel disconnected from collective actions. This perception of separation disguises the intuitive knowing about the essential human connectedness. It also leads to the ignorance of the interdependence between life and people. This mind-set can be assumed a one possible factor for preventing learning and seeking simple solution, often cause for e.g. radicalisation of political thinking and unwanted success of radical populism (Schneider 2015). Multi-stakeholder initiatives for societal change, however, contribute to increasing awareness and acknowledgement of multiple realities. Such collective learning settings that expose actors to different world-views help to develop self-reflective personalities. Collaboration for an issue of common concern as well as exposure to different realities often changes attitudes towards contribution. The question: "How can I excel or what will I achieve? Or, what is in it for me?" will shift towards the question: "What can I best contribute to further this processes of change? Which direction would serve the collective good?" (Kuenkel 2008). Focussing on these questions, shifts individual and collective thinking into future orientation, where everyone can bring in their own unique potential (Kuenkel 2016).

5 An Approach to Learning Collectively: The Collective Leadership Compass

The above elaborations have argued that collaboration for sustainability transformation in multi-stakeholder settings can be seen as one way of advancing both individual and collective learning. However, if Senge's notion of mastery could be transferred to collective learning settings, it would be helpful to make use of methodologies that enable actors to learn faster together. One such methodology should be presented here.

The Collective Leadership Compass is a guiding tool for transformational change processes that take place in multi-stakeholder collaboration (Kuenkel and

Aitken 2015). It enhances both individual and collective learning processes. Derived from 20 years of practice in complex multi-stakeholder settings around system's change for sustainability as well as scientific exploration into living systems theory (Capra and Luisi 2014), the compass is both a diagnose tool and a process methodology. It focuses on invigorating human interaction and learning systems as core drivers of transition processes and helps to assess, plan and enact the collaborative change required for sustainability. It supports actors to navigate complex challenges by introducing a guiding structure, which becomes a fractal of the learning and collaboration patterns that are needed for the change envisaged. It draws attention to human competencies in six dimensions: *Future Possibilities, Engagement, Innovation, Humanity, Collective Intelligence, and Wholeness* (Kuenkel 2016).

Initiatives aiming at sustainability transformation can be seen as complex change endeavors. They start with people who consider *future possibilities.* Individuals sense a potential future and a vision for a future is usually developed by a group of people. Over time the potential grows into a more structured change initiative or even a movement. The dimension of *future possibilities* refers to the human competency to take responsibility and consciously shape reality towards a sustainable future. However, even the greatest visions for change are futile if not enough stakeholders are prepared to commit to action. Effective multi-actor settings therefore require sufficient *engagement* of stakeholders—the powerful and the less powerful, the influential and the affected. Meaningful stakeholder engagement processes create trust and cohesion, invigorate network connections, and foster collective action that leads to tangible outcomes. The dimension of *engagement* refers to the human competence to create step-by-step engagement towards building effective collaboration eco-systems. However, if novelty does not also enter a collaboration system, the process might not move forward, if actions and behaviors that led to the current situation are re-created. Although learning from the past is valuable, it should not limit actors to create new variations of existing solutions. The dimension of *innovation* refers to the human competency to create novelty and find intelligent solutions. However, innovation that does not take the shared *humanity* into account can create unsafe environments. Awareness of the human story has both an individual and a collective perspective. Collaboration systems are able to shift towards constructive solutions when there is mutual respect and acknowledgment of the intrinsic value of all people, regardless of different opinions and viewpoints. The dimension of *humanity* refers to the ability of each person to connect to their unique human competency in order to reach out to each other's shared humanity. Increasing awareness, however, requires exchange with others about the actions to be taken. It is evidenced that life thrives on diversity, and so do human collectives. Meaning–making frameworks—offline or online—rooted in dialogue between human beings are essential to collective learning in multi-stakeholder collaboration—if balanced with all other dimensions. The dimension of *collective intelligence* refers to the human competency to harvest differences for progress. However, all collective moves towards sustainability need to be embedded in people's ability to sense *wholeness*, and attend to the needs of

planet as a whole. When people are able to take a larger perspective, they are often able to shift to new insights, better understand the coherence of a situation or at least attend to the needs of the next level system they belong to. Gaining perspective and seeing a collaborative change effort from within a larger context is a relative, yet important step, in developing 'collective mastery'. People aiming at changing a situation are often trained to focus on fragments of reality, on a small fraction of a larger story, or on their own field of expertise. The dimension of *wholeness* refers to the competency to see a larger picture and stay connected to the common good.

These six dimensions are interlinked and related. Rather than simply adding to one another they lead to results through their interconnectedness as a recurring pattern of human competencies. The application shows that, once this pattern emerges in complex collaborative sustainability initiatives, people learn faster. They are more forthcoming, conflicts can be laid to rest with an acknowledgement of difference, and generally collaboration is leading to better results in less time. This gave rise to developing the compass (see Fig. 1) as a navigating framework to enhance collective learning and collaboration effectiveness based on both observation and research (Kuenkel and Aitken 2015).

The compass in Fig. 1 helps human competences to surface through a meta-structure that does not prescribe action, but helps fruitful options to emerge. It strengthens individual leadership and learning, enhances the learning capacity of a collective to lead complex change (Kuenkel 2016). Table 2 shows the overview of the six compass dimensions and their competencies.

6 Enhancing Collective Learning: The Conceptual and Experiential Background of the Compass

Apart from the experiential observations regarding learning capacities of stakeholders in 20 years practice of supporting international multi-actor collaboration processes, the compass dimensions have been developed on the basis of research into knowledge streams relevant for the understanding of co-creative human evolution. They have been refined following qualitative interviews with change practitioners in multi-stakeholder collaborations addressing sustainability issues (Kuenkel 2016). The following selected conceptual thought had the most significant influence on developing the *Collective Leadership Compass*.

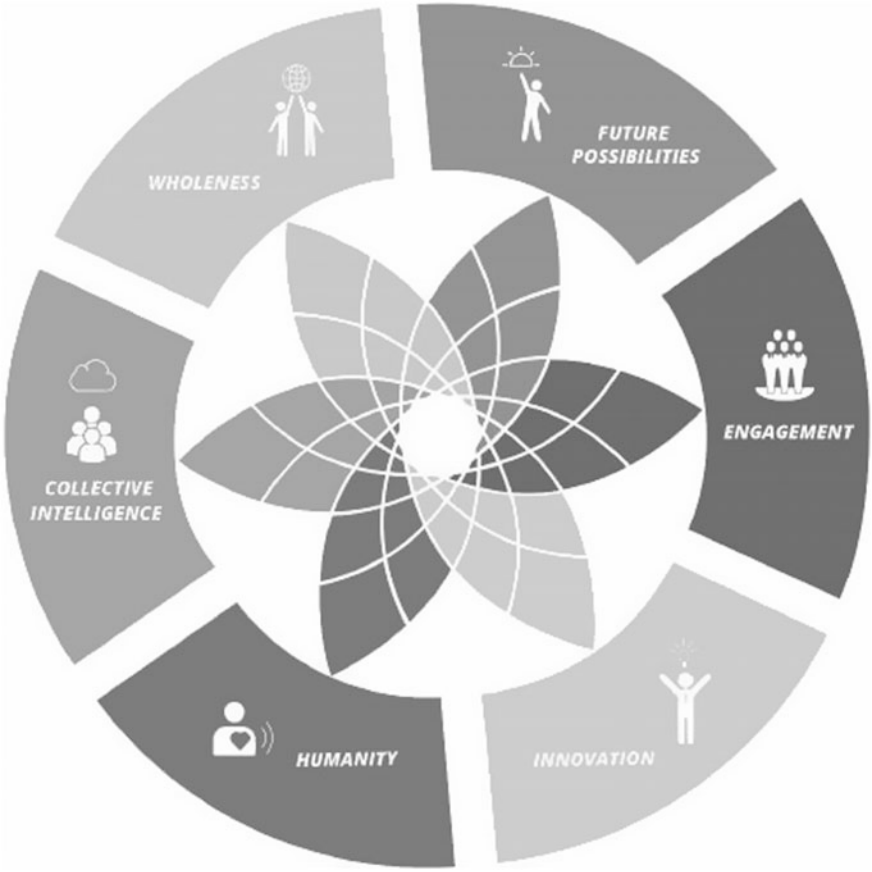

Fig. 1 The Collective Leadership Compass (own representation by Kuenkel 2016)

Table 2 The six dimensions of the compass and their competencies (own representation by Kuenkel 2016)

Dimension	Competency
Future Possibilities	Take responsibility and consciously shape reality toward a sustainable future
Engagement	Create step-by-step engagement toward building effective collaboration systems
Innovation	Create novelty and find intelligent solutions
Humanity	Reach into one another's humanness
Collective Intelligence	Harvest difference for progress
Wholeness	See a larger picture and stay connected to the common good

7 Living Systems Theory, Complexity Theory, and Chaos Theory

An important feature of natural (including human) systems is their characteristic of relationship patterns ordered in the form of networks with constant internal communication (Capra and Luisi 2014). Although systems can be organisationally closed (e.g. institutions) and have visible boundaries (e.g. legal form), when viewed in a larger context it is almost arbitrary where to draw the boundaries of a system. Each boundary merely becomes a threshold to the next level of the whole, the larger system (Sahtouris and Lovelock 2000). This leads to the conclusion that a methodology that should guide collective learning in collaboration systems needs to mirror such a referential relationship patterned order. The key to a negotiated balance in collaborative change is diversity, in nature—and also in social systems—a crucial requirement for the resilience of a system (ibid., 2000). The greater the diversity, the more sustainable a system becomes in the long run. This also applies to multi-stakeholder collaboration initiatives. They are built on internal relationship patterns and a shared context of meaning (Luhmann 1990) sustained by continuous conversations. Multi-stakeholder collaboration for sustainability can be captured as a way of forming temporary, goal-oriented systems of collective human learning. Because of their temporary nature and—in contrast with institutions—their loose structure, they can be seen as catalyzing societal learning processes that go beyond those of institutions and individuals. They are laboratories for what Senge (1990, p. 16) suggests as "[…] the capacity of a human community to shape its future and specifically to sustain the significant processes of change required to do so". The *Collective Leadership Compass* guides attention to a relational pattern of dimensions that, if appropriately balanced in interaction enhances the effectiveness of collaboration. The dynamic, yet consciously balanced actions become a fractal of the resilience of the collaboration system. While all dimensions resemble important dimensions for collective learning systems, the dimension of *collective intelligence* is the entry point to enact resilience through diversity of perspectives, expertise and experience.

8 Conceptual Approaches Around Dialogue and Ethical Know-How

In the *The Future of Humanity* the Western physicist David Bohm and the Eastern metaphysician J. Krishnamurti (1986) have a conversation about the basic assumption that human thought creates divisions—between 'me' and 'you' and between 'me' and 'the world'. It then acts on these divisions as if they were facts. To nobody's surprise, the human mental activity shows up as polarisation in the world: difference, disparity, and conflict. Each person struggles alone, trying to achieve peace, happiness, and security. And yet, the very attempt to separate one's

own happiness from the suffering of others would be a reinforcing activity maintaining separation and creating more suffering, more disparity and more conflict. In his lectures on Ethical Know-How that he held in Italy, Francesco Varela noted that human perception is not the representation of a pre-given external world, but in itself a co-creator of reality (Varela 1999). Hence, ethical expertise, for him, is not a skill, which we acquire, but a natural state we unearth when we remove the layers of obscured consciousness and begin to see this very nature of reality. We become empathetic with humankind and the world if we enact or free this inner disposition. The six dimensions of the *Collective Leadership Compass* serve as a lens into accessing the ethical awareness Varela emphasises. Both the dimension of *humanity* and *wholeness* are entry points that enhance ethical thought and action. By supporting individuals and groups to move towards a more constructive pattern of co-creation, they free the human disposition to contribute and make a difference.

9 The Pattern Language Approach

In his pattern language, the architect Alexander (2002) suggests that the structure of elements in an architectural space creates a response in the internal structure of a person. The more the external structure is composed in a life-enhancing way with centres of attention that mutually reinforce each other, the more the person feels alive (or human). Structure can thus enhance or impede the vitality and learning capacity of a human system. The dimension of *wholeness* is an entry point into enhancing the vitality of a collective learning. The *Collective Leadership Compass* functions as a structured space with a mutually supportive pattern of centres of attention. This contributes to vitality—in the person, in groups, in collaboration initiatives, and in human systems.

10 Leadership Approaches Based on the New Science

For a long time, leadership has been looked at as the capacity of individuals (Kellermann 2012), but it is argued here that it is time to explore not only learning, but also leadership as the capacity of a collective—be it a team, the core group of a multi-stakeholder collaboration initiative, or the senior leadership group of a corporation. As individuals and teams carry more and more responsibility in complex multi-actor change initiatives, this capacity to become constructively co-creative grows in importance (Kuenkel 2016). The dimension of *future possibilities* and *innovation* are entry points to collectively create novelty.

11 Development Theory and Societal Learning

With rising global sustainability challenges, the understanding of how collective learning takes place, becomes increasingly more important. This is the cornerstone of our response to the global sustainability challenges, irrespective of whether it is about creating responsible patterns of production and consumption or improving life for all in a city. A brilliant example for this is the idea of creating shared value as outlined by Porter and Kramer (2011). They argue that in advanced economies the need for products that better meet societal needs is growing fast—be it energy saving devices, clean cars, or better nutrition. With societal needs in mind, uncounted avenues for innovation are opening for companies who think several steps ahead. Multi-stakeholder collaborations create learning advantages, for the public sector as much as for the private sector. Yet people differ as their assumptions and experiences are formed by culture, knowledge, theories, practices as well as their particular way of seeing reality. Depending on their professional background and institutional embeddedness, they favour particular strategies while they ignore or dispute others. The dimension of *engagement* functions as an entry point for societal and global change endeavours.

12 From the Individual to the Collective

Both the literature reviewed and the observations from multi-stakeholder collaboration hint to a deeply human capacity to more consciously act and reflect in a collective learning space. The global sustainability agenda requires many more actors to become more knowledgeable about how collective learning capacity can be further developed. The qualitative study with 30 practitioners from local and international stakeholder multi-stakeholder collaboration initiatives (Kuenkel 2015) that informed the development of the *Collective Leadership Compass* showed that the success of their initiatives hinged on the way collective learning processes were enabled. Four of these enabling processes could be identified:

- **Fostering trust building** through respect for difference, invigorating passion for the future and putting effort in finding common ground. This confirmed the importance of enhancing *Humanity* and *Future Possibilities*.
- **Modelling evolutionary change processes** through step-by-step engagement of stakeholders with focus on creating results collectively and ensuring a good flow of communication. This confirmed the importance of enhancing *Engagement* and *Collective Intelligence.*
- **Invigorating connectivity** through developing personal networks that grow into interconnected movements for change as a contribution to the common good. This confirmed the importance of enhancing *Engagement* and *Wholeness.*

- **Creating patterns of vitality** through enabling actions of mutual support that balanced flexible containment through agreed upon rules and structures with creativity and the capacity to learn and adapt quickly. This confirmed the importance of enhancing *Innovation* and *Wholeness.*

The probably most suitable comparison in the way the compass creates effectiveness is the balanced scorecard (Kaplan and Norton 1996). A balanced scorecard leads to results if all its elements get sufficient attention in an appropriately balanced way. It can be used as diagnostic tool, planning tool and evaluation tool. The same applies to the compass. The decisive difference, of course is, that the compass addresses collaboration competency and quality—as important contributors to complex change and the resilience of a system. It does not measure in any way the overall performance of a company, institution or even a multi-stakeholder partnership. Rather than putting key performance indicators behind the six dimensions, it makes sense to use them as a lens that guides collective learning in planning, action and reflection. An atmosphere of leading collectively becomes the natural way to create the future when these six dimensions are consciously attended to—within individuals, in groups of leaders, and in multi-actor settings (Kuenkel 2016).

13 How Working with the Compass Can Enhance Individual and Collective Learning in the Context of Sustainability Transformation

The *Collective Leadership Compass* strengthens peoples understanding of the complex journey into a more sustainable future that need to be traveled together. It can motivate people to change their behavior when they resonate with future possibilities that makes sense to them and touches their hearts. There will always be barriers in human collaboration, but strengthening the pattern of human competencies through collective learning increases the resilience of the system of actors and their capacity to better co-create a sustainable future.

The dimensions are not new, but what makes the difference is paying conscious attention to their *joint* presence. This can help actors navigate through human difficulties and enhance the vitality of individuals and collectives—and particularly collaboration systems. As a collective, collaboration systems become more *resilient* —a capacity needed in a complex, interdependent, and constantly urgent world (Kuenkel 2016, p. 49).

Depending on the issue and the context of multi-stakeholder collective learning processes for sustainability the six dimensions can be enhanced in different way. What follows are exemplary approaches to further the different dimensions.

14 Enhancing the Dimension of *Future Possibilities*

Every multi-stakeholder initiative requires a clear set of goals, expected outcomes and a stated desired impact, often accompanied by a thought-through theory of change. Yet, such collective learning and implementation efforts are not only complex, but also operate in complex environments that are volatile und unpredictable. Developing common goals and a shared vision supports this dimension, which in turn creates an emotional connection with a future state to be arrived at together. Collective learning is best enhanced when such goals function as guidance, but are not entirely fixed. Details, including interventions designs, need to be flexible and iteratively adapted.

15 Enhancing the Dimension of *Engagement*

For sustainability challenges a variety of approaches and interventions is needed, most importantly because each issue of common concern may have different stakeholders. There is no single all-effective strategy to engage all of these stakeholders in a system of collaboration. But what is important is taking a step-by-step approach to engaging stakeholders in collective learning processes. If the circle of involved is too large in the beginning, actors may shy away from any interest in collective learning. Once there is a group established that has developed learning structures, the circle can be widened and more and more actors can be invited to join. In complex change processes such as urban development collective learning needs to be organized across societal barriers. Key to learning are change designs that are implemented across institutions and form a multi-stakeholder learning system. This strengthens mutual understanding and network development.

16 Enhancing the Dimension of *Innovation*

Most logics of collaborative change initiative aim at solving a specific problem. They define deficits to be overcome. While this is important, it is only part of a reality in a complex system of actors related to societal change for sustainability. What becomes increasingly important to go beyond the focus on already existing approaches to solution finding? This could mean to search for already existing unusual ways of dealing with a problem or creating innovative spaces to approach the problem in a new way. Innovation is enhanced when actors deliberately nurture emergent ideas and practices through supporting promising initiatives or mapping good practices.

17 The Dimension of *Humanity*

Most complex multi-stakeholder initiatives that aim at sustainability transformation do not emerge in superficial harmony. On the contrary, even if a small group of like-minded pioneering actors comes together at the beginning, the more the collaboration systems grows, the more conflicts will arise. One very common human reaction to complexity is to insist that one's own way of approaching change is the only possible. Yet, transformation needs not only a multiplicity of strategies and actions, but also a variety of thought, knowledge, expertise, ideas, experience and world-views. At the same time collaboration systems among multiple stakeholders are only effective, if there is a sufficient degree of trust. Respect for difference turns out to be a crucial element in moving from conflict to cooperation. Appreciating the dignity of people as people, acknowledging different world-views, and opposing opinion without necessarily agreeing, are cornerstones for building effective collaboration. All this goes a long way to fostering trust and, above all, unleashes a dynamic of contribution that is required for achieving vision and goals.

18 Enhancing the Dimension of *Collective Intelligence*

As mentioned before, collective reflection in multi-stakeholder collaboration systems is a prerequisite for collective learning. Joint reflection about the collaborative endeavour and its many facets are indispensable for achieving impact. This is the only way to prevent falling back into isolated action. Collective intelligence is the key transformative competence that emerges when good collaboration between a diversity of actors is underway. It furthers a shared understanding of the complexities presented by the challenge of sustainability, but also enhances the competence of different actors to create new ideas and spot new possibilities. For collective intelligence to emerge it is important to create structured settings for dialogue and deliberation. This can take the form of best practice exchange, market places, field trips, structured stakeholder dialogues, innovation labs, future designs, or strategic workshops—whatever is appropriate. Shifting the communication and interaction patterns between stakeholders is at the heart of collective learning.

19 Enhancing the Dimension of *Wholeness*

For collective learning to occur, it is important to locate the collaborative change effort within the larger system, and stay aware of other change efforts. This is greatly supported by conducting a context and situational analysis at the beginning of a multi-stakeholder collaboration initiative. This is often a step into creating even larger collective learning systems, such as networks of multiple actors around an

issue of common concern. Such networks can be local, national or international. It is the learning exchange at the network level that supports implementation in the individual initiative. There is an enormous fragmentation of efforts, if not competition. Initiatives operate in similar fields, often duplicating efforts or only addressing narrow solutions. Taking a systemic approach to strengthening collective learning in multi-stakeholder collaboration suggests ensuring that the connection to other initiatives is created and maintained.

The compass is built on the acceptance that societal change is not only inevitable, but can be welcomed if shaped collectively. It is anchored in the attention to human competencies. Acknowledging one another's competencies and each person's capability to shape the future by accepting different levels of experience and implementing diverse strengths at the right moment can accelerate collective learning processes that take society into a better future (Kuenkel 2016, p. 50).

20 Conclusions and Outlook

We have argued that lifelong learning needs to be seen not only as an individual, but a collective process, and have suggested that multi-stakeholder collaboration for sustainability issues is an interesting laboratory for understanding what accelerates collective learning. In our view, this is key to the long-term flourishing of human societies and to the planet as a whole. Learning always takes place in a collective by sharing information and experiences. We have presented a methodology derived from the practice of multi-stakeholder collaboration and scholarly investigation into various research backgrounds that strengthens collective learning through paying attention to human competencies. The *Collective Leadership Compass* has been described as a process-oriented methodology and a guiding tool composed of six dimensions that are based on living systems theory. Implementing the Compass in transformational processes such as multi-stakeholder collaborations helps to increase awareness and get a deeper and reflective insight into complex circumstances to be able to operate in collaboration patterns. Collective learning in multi-stakeholder collaboration can counterbalance sustainability threats and help address some of our most urgent challenges for humankind.

The need for more and better collaboration for sustainability requires scaling both research and practice into better functioning learning collectives. This chapter suggests an investment into research on how to build the capacity of groups of actors to become catalysts for large systems change in complex multi-stakeholder settings. Investing in education and lifelong learning is the most important step for leading into a sustainable future. Further research could include exploring how methodologies such as the *Collective Leadership Compass* could contribute to collective learning in online-settings, involving a wide range of stakeholders, and such processes can be supported with online tools. Further exploration should go into the foundations for positive attitudes towards collective learning in the form of collaborative setting at school and how the compass could support such processes

and anchor such an approach early enough. Similarly, research could investigate in the role of collaboration as prerequisite for collective learning in organizations, government entities, and in especially in companies that have started to embark on sustainability strategies.

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Lifelong Education: Citizenship Lessons for Life in More Sustainable Communities?

Adriana Gelpi, Rosa Maria Locatelli Kalil and Wagner Mazetto de Oliveira

Abstract The objective of this paper is to present participatory research on urban planning, sustainability, and education for citizenship. The study is justified by the urgent need to develop actions to promote the relationship between undergraduate and graduate courses to improve the quality of primary education. The study aims to integrate, implement, and communicate urban planning and sustainability concepts in the community. It includes primary school students and teachers as well as university researchers (academics), and through interdisciplinary integration, contributes to improving the education process. To develop this research, partner schools were selected based on their location in the urban fabric and physical, social, and territorial conditions. The research was implemented in two stages. The first stage was conducted in the school and university offices, and the second involved a field survey to identify routes in the city and around the university. The results of this research increased the awareness of the community of citizenship and the right to the city, as well as their knowledge of urban planning, sustainability concepts, and critical thinking on the process of urban development. Community living increased the academics' awareness of the real needs an urban project should address. Furthermore, the primary school students were able to develop a critical outlook of the urban space they live in, and then contribute to sustainability and citizenship.

Keywords Participatory research · Urban planning · Education for citizenship Sustainability · University-primary education integration

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1 Introduction

According to a report by the Coordination for the Improvement of Higher Education Personnel (Capes) (Brasil 2010), the scientific development of the last decades has influenced important themes for humanity such as environmental preservation, increased food resources, advances in medicine, urban sustainability and mobility, media socialisation, and improved quality of life.

However, the report emphasises that development, which benefits people's quality of life, must be monitored to ensure objective improvement and larger social influence in its employment. This implies a new contract between science and society to ensure that scientific progress solves problems that influence humanity and includes all segments of the population.

In Brazil, despite numerous scientific and technological advances, these have not been transformed into knowledge socialisation. As such, at the beginning of the third millennium, the Brazilians' low level of education has been confirmed. Therefore, it is concluded that the technical knowledge developed by the scientific community has not benefited much of the community. This lack of knowledge prevents further advances in scientific development.

Studies by Capes in Brasil (2010) address the implementation of actions to provide post-graduate programs to improve primary education to ensure interdisciplinary integration of these institutions. This is based on the belief that the concern of higher education institutions such as the National System of Post-Graduation might significantly contribute to the country's quality of education.

However, beyond education—and consequent to its low relevance—in the 21st century in Brazil, few people have achieved the right to the city and to built sustainable spaces as well as to life characterised by urban quality. Maricato (2001) states that access to housing spaces is limited in cities, adding that not enough social policies meet the needs of most of the population. In this scenario, alternatives such as illegal or informal housing are all that usually remain for the low-income community.

In more recent work, namely 'The impasse of urban policies in Brazil' (Maricato 2011), the author approaches the concern leading us to the purpose of this work, namely that the construction of a new paradigm of education and its reflection in cities demands a cultural change. She says that to fight *urban illiteracy* (2011, p. 45), a pedagogical campaign addressed to civil service employees; social, professional, and academic students; and union leaders such as students, journalists, and intellectuals is necessary.

Maricato asserts that 'knowing the reality of Brazilian cities and the specific reality of each city requires the incorporation of a theme as a school subject in the fundamental school' (2011, p. 45). In this context, the objective of this work—first as a research issue—is the challenge of diffusing the concepts of urban sustainability and planning for the community among students and teachers in the public primary education system and at the University of Passo Fundo (UPF) to contribute to the process of educational qualification through interdisciplinary integration.

2 Justification

The chapter, *Primary Education: a new challenge for the SNPG*, the National Plan of Post-Graduation (PNPG) in Brasil (2010, p. 157), states that the scientific development of the last decades must create a new relationship between science and society. It continues that this 'can only exist if all citizens own scientific development and a culture that allows them to understand and administer their everyday lives to face and integrate themselves critically and autonomously in this life. Nowadays, the use of citizenship requires knowledge of science and the methodologies scientists use in their research'.

The text elaborates that the challenge is composed of two axes: improving the scientific base to follow scientific developments and making this knowledge available to all Brazilians, primarily children and youngsters (Brasil 2010, p. 157). This explains the urgent need to develop special actions that provide post-graduate articulation by improving the quality of primary education. This issue will be important in helping overcome the challenges of National Education in the next decade in terms of education qualifications and the initial and continuing development of professors. Several programs support this ideal, including Capes' National Program of Teacher Formation (PARFOR) and the Program of Scholarships for the Introduction to Teaching (PIBID).

When aiming to advance learning efficiency and guarantee the right to learn, schools must develop activities that articulate with students' reality to enhance local culture and the use of citizenship at different stages of development. To cope with this diversity, teachers must develop a pedagogical framework with students to motivate them to stay in school and new pedagogical practices to which post-graduate programs can contribute (Brasil 2010).

The relationship between high and primary education has been proposed as a factor that qualifies teaching at all levels. Besides the right to education, established by the Federal Constitution of 1988 and implemented by the Law of Guidelines of the Brazilian Educational System in 1996, this concern is highlighted in normative documents such as the PNPG 2011–2020 and National Plan of Education.

Regarding the post-graduate area Engineering I, in which includes the UPF's Graduate Program in Civil and Environmental Engineering, 'interaction with the fundamental school and high school' (Brasil 2013) can be improved by the activities proposed in this research, which includes researchers and students of the university and professors and students currently in the fundamental teaching phase.

The concentration of the Master's degree in Infrastructure and Environment at UPF considers the theme of urbanisation and sustainability, focusing on territorial planning and the management of infrastructure. This line of research 'approaches themes related to comprehending the territory occupation process and the planning, management, and projects of its infrastructure and environment to qualify the relationship between the natural and built environment from the perspectives of sustainable development and the population's quality of life' (UPF 2014).

The relationship between science and society will only exist if citizens own scientific development and culture, which allows them to understand and administer their everyday lives and make decisions based on their own knowledge. As such, citizenship demands scientific knowledge. However, this suggests challenges. On one hand, we must increase the scientific base to follow worldwide development. On the other, this knowledge must be made available to all Brazilian citizens.

Integrating the challenges of this proposed planning, education, and citizenship, Volkmer (2005) observes that studies on the transversal themes and discussions on curricular programs in schools may enhance knowledge, heritage, and the use of citizenship. These prerogatives, implemented by the MEC, invite the introduction of interesting discussions on the built patrimony.

Regarding cities and the built space, Soares (2005) refers to educational experiences, the objective of which is to encourage a critical position in communities as well as reflection and thinking on cultural heritage. Teaching activities and research must elucidate concepts to increase people's awareness of the importance of heritage to the social memory of generations, without exclusion and discrimination. To understand oneself as a citizen, it is necessary to understand and respect the surrounding space and establish social, regional, and world differences, considering the time and set of representations.

Maricato (2011, p. 45) notes that Brazilians' significant and generalised ignorance of their geographical space makes knowing the reality of the set of cities in the country urgent. She adds, 'it would be feasible to eradicate or at least minimise urban illiteracy, the alienation related to urban space, and the strengths that control it, and create a new culture and new level of knowledge of the cities of Brazil, disseminating proposals created by movements of urban reforms'.

In this sense, the proposal of a research project on urban planning and sustainability, and its materialisation in the area is justified. It integrates and increases the awareness of students in primary education schools of development work. The issues addressed will contribute to understanding the organisation of urban space to enhance these spaces and implement the maintenance of biodiversity and citizenship principles.

3 Objectives

According to Public Notice 03/2014 of the Foundation of Support to Research in the State of Rio Grande do Sul (Fapergs) and Capes, in accordance with the Program of Introduction to Sciences, Mathematics, Engineering, Creative Technologies, and Letters (PICMEL), which encourages a scientific vocation for young students in public fundamental and high schools in Rio Grande do Sul, the research reported here improves the activities reported and published in a study entitled 'Medium cities, planning, and sustainability: The case of Passo Fundo/RS'. This research was achieved with the support of Fapergs in 2012/2013.

At this stage, the proposal included students, professors, and public fundamental schools in Passo Fundo in a study focused on the fields of Engineering and Social Sciences. This involved communities located in peripheral and low-income areas of the city in activities initiated by the Graduate Program in Civil and Environmental Engineering, with a concentration in Infrastructure and Environment in the Civil Engineering program. Furthermore, activities were also performed by the Urban and Regional Studies Laboratory (Laburb) of the Architecture and Urbanism Undergraduate program at UPF. As such, the objectives were as follows:

- To establish research and activities integrated between UPF and fundamental schools in Passo Fundo to approach issues related to the city, urban planning, sustainability, and citizenship.
- To present and analyse the planning of territorial organisation proposed by the Master Plan of Integrated Development of Passo Fundo (PDDI) (Passo Fundo 2006) to the city and urban guidelines for areas to be researched (neighbourhoods with schools) according to the proposed methodology.
- To verify if the planning guidelines identified for the study areas represent aspects of urban sustainability.

4 Review of the Literature

In terms of school levels, the Law and Guidelines of the Brazilian Educational System (LDB) (Brasil 1996) states that the purpose of primary education is to develop the student for the use of citizenship. For higher education, among other objectives, the LDB focuses on cultural creation, scientific development, and reflexive thinking, encouraging research and investigation. The aim in higher education is to develop technology, create culture, and promote the publishing of cultural, scientific, and technical knowledge.

However, despite these broad objectives, the PNPG (Brasil 2010) addresses the low performance of primary education students, considering that there is no satisfactory use of the teaching and learning process. This demonstrates the need to consider Brazilian education as a whole in a systemic not sectioned manner, which is the current approach. As such, the PNPG encourages post-graduate programs to focus on societal demands, especially in primary education, promoting significant learning from the perspective of social demands and individual development in an integrated way.

Interpreting the expressed right to education is a way to initiate this debate, as defined in article 205 of the Federal Constitution. This right can be understood as going beyond access to school and means the right to learn. To ensure that this right is guaranteed, it is necessary to provide inputs and develop attitudes that can promote more effective learning. This might cause people to reconsider the educational system (Brasil 2010).

In this context, Capes (Brasil 2010) proposes that graduate programs contribute to improving the quality of education by implementing learning that addresses social demands and individual development to meet the needs of Brazilian students, who demonstrate different abilities and interests. This is to ensure their right to education by considering the pluralism of ideas and pedagogical concepts.

Improving the quality of primary education is a great challenge that must be strategically addressed to ensure the economic and social development of the country. For Capes (Brasil 2010), program development is organised by multidisciplinary teams, making the involvement of graduate courses feasible in terms of widening debates. By limiting programs only in education, it is hoped that the participation of various fields will bring new ideas to the system, which can help to identify alternative pathways to improve the quality of primary education.

It is understood that schools must develop activities that articulate with students' reality to enhance local culture and the use of citizenship. However, identified difficulties include ensuring the permanence of youngsters in school and low levels of learning. These difficulties indicate that high school, as a stage of primary education, is currently characterised by inadequate pedagogical procedures. The quality of information created and used every day and the presence of technology in students' lives constantly puts into question the information professors bring to the classroom, showing the urgent need to change current procedures (Brasil 2010).

Therefore, facing new challenges such as establishing innovative experiences and avoiding monotony inside the classroom are difficult achievements. Thus, these trans-disciplinary experiences such as those at the theatre, museum, outdoors, or downtown, among others, still face strong barriers in the academy. Perhaps these barriers stem from the technical teaching established throughout compulsory history, where issues relating to the constitution of practices that can make people think and act in a critical and pleasant manner were left behind.

On the other hand, integrating educational experiences to encourage critical and reflective thinking alongside the community stimulates thinking about passive or careless attitudes towards living, study, and work spaces. The cultural and built heritage as an object of dynamic academic activities can be a pathway and contribute to the development of more critical attitudes and increased awareness, thus enhancing the preservation of cities and the construction of citizenship.

Volkmer (2005) maintains that the achievement of activities now proposed by Capes (Brasil 2010), namely integrating the research of the academy with the community, may allow a dialogue between research, education, and citizenship, turning cultural heritage into an important integrating element. The author observes that the dialogue between the university and community, utilising the city as an enabling element of interaction, is an interesting strategy. In other words, the urban planning and sustainability approach might be a challenge in the production of socially relevant scientific knowledge.

The experience of some education institutions regarding work with communities shows that it is possible to significantly improve the quality of education by developing good practices appropriate to the school community. There are different pathways through which to develop education high in social quality, although this

means that the school community must be committed to the development of a shared and democratic educational project. In this sense, the development of special actions that promote the relationship between graduate courses and the improvement of primary education through interacting with professionals in continuing education is demanding.

5 Research Methodology

This research approaches urbanism and sustainability as pathways to education and citizenship. The study was conducted in 2014–2015, and included students and teachers from two primary education public schools, namely Escola Municipal de Ensino Fundamental Guaracy Barroso Marinho in the José Alexandre Zácchia neighbourhood and Escola Municipal de Ensino Fundamental Jardim América in a neighborhood of the same name, located in the urban periphery (Fig. 1).

As a study case, guidelines that address the PDDI (Passo Fundo 2006) were verified and selected for this research, and implemented in the study areas considering the principles of sustainability. An initial challenge was integrating, employing, and publishing the concepts of urban sustainability and planning in the community with the primary education students and teachers of Passo Fundo. Through interdisciplinary integration, the aim was to contribute to the quality of the educational process.

As the next step, it was proposed to recognise, analyse, and interpret the city's urban expansion before planning under the aegis and guidelines of sustainability provided by the Statute of Cities (Brasil 2001) and proposed in the PDDI. This included increasing young students' awareness of urban, environmental, and citizenship issues. The theme of this work was participative research on urban planning, sustainability, and education for citizenship. This is justified by the urgent need to develop special actions that promote the relationship between graduate and post-graduate programs by improving the quality of primary education.

Fig. 1 Location of the schools and neighbourhoods that participated in this research. *Source* The authors: based on Google Maps (2016)

The main objective of the research was to include students, teachers, and public schools in a study focused on the fields of Engineering and Applied Social Sciences, while involving communities located in peripheral and low-income areas of Passo Fundo. Through this research, it was possible to integrate the Post-Graduate Program in Infrastructure and Environment, the Laboratory of Urban and Regional Studies, and the Architecture and Urbanism course at UPF. Other objectives included the presentation and analysis of territorial organisation planning proposed by the PDDI of Passo Fundo (2006) to the city and the researched areas. As another objective, it was verified whether the planning guidelines identified in the study area included aspects pertaining to urban sustainability.

Specific objectives were to employ, elucidate, publish, and research issues related to the city, urban planning, and sustainability. To analyse the PDDI guidelines for Passo Fundo city and the selected areas, topics related to the territorial organisation, constructive indexes, and aspects of urban sustainability were identified. The field research aimed to map and graphically and digitally record the local urban landscape, document areas at risk, and determine the potential for the sustainable development of these areas.

Considering the city as an ecosystem, Agyeman (2003, p. 452) understands that 'urban ecosystem education must become part of a large and lasting process of learning that helps people predict and define what communities and cities are sustainable within the short and long term'.

The methodology adopted the concept of citizen science, which was developed by Irvin and Agyeman (Agyeman 2003, p. 457) as a component of moving towards sustainable communities and a long-term objective. This approach to science and expertise offers at least the potential for dialogue between scientific and citizen groups.

The population's participation takes time, and can be of several modalities. For example, Agyeman (2003, p. 457–462) describes the activities of students in Detroit, who addressed problems in their residential areas (crime, drugs, pollution, precarious houses, and others). Furthermore, the author discusses the activities of Asian women in Bradford in the United Kingdom, who grew vegetable gardens comprising a mix of Bangladeshi and British plants. The author concluded that to help people build, transform, create, and emancipate their world for communities and sustainable cities, they must begin in their current locale. Participative research agendas, where the professor (researcher) is a co-learner and the learner is the co-researcher, develops a strong learning pedagogy for professors, researchers, and others involved in education on urban ecosystems to develop communities and sustainable cities.

As the study refers to an approach to cities for people, the research was based on the approach by Harrison and Burguess (2003, p. ix), in which the relevant educational tools must consider: (1) the complexity of the cities; (2) the dynamic nature of the cities as places where change is the norm and directed by multiple interacting forces and conditions; (3) the vital role performed by special relationships, human and other disturbances, and historic influences in the urban environment.

In terms of the urban space analysis, the readability concept of Lynch (1997) was considered. In a study on the quality of urban landscapes and space, Caquimbo Salazar (2009, p. 75) considers that the mentioned author 'brought in a closed idea of landscape as a mental construction through the concept of an environmental image that arises from the relationship with the city's physical space'.

The research methodology was implemented in two stages. The first stage was implemented in offices at the university and schools. In the second stage, a field survey was conducted. The first stage relied on seminars of themed presentations related to urban planning, the integration of students of the school and students of the Architecture and Urbanism course at UPF, development of workshops on mapping the town and Passo Fundo city, identifying guidelines that address the Master Plan of Integrated Development, the location of the school, and references of the city's urban spaces. The second stage dealt with the recognition and documentation of: (a) the neighborhood urban landscape; (b) urban land limits and use; (c) availability of community and services equipment; (d) urban mobility; (e) urban and sanitation infrastructure; and (f) systematisation, analysis, and interpretation of the data collected.

6 Results and Discussion

The results of this research were actions related to citizen awareness and the right to belong to the city, as well as knowledge on urban planning, ideas of sustainability, and the development of a critical outlook of the urban design process. The research involved the community, the school, and the neighborhood. In this way, the objectives intended in the project proposed by Capes and Fapergs were fully met, extending university scientific initiatives to community schools.

As such, the results reflect Agyeman's assertion (2003), which considers that people's transformation and training are important for the emancipation and construction of sustainable cities starting with their own locale. Another aspect approached by the author and directly reflected in the results of this work concerns the participative research agenda, wherein the professor is a learner and the student a co-researcher. Therefore, we report that for academic students and managers at UPF, living in the community and the school community alerted them to the real needs an urban project should address. At the same time, students from municipal schools were trained to adopt a critical thinking approach to the urban space in which they live.

The community professors' training to develop the project demonstrated that a strong learning pedagogy for professors, researchers, and managers involved in education on urban ecosystems is needed for the development of sustainable cities and communities.

The participation of exchange students, who have different viewpoints on education, culture, and urban space, enlightened participating students and communities. As such, they substantiate Volkmer's assertion (2005) on the transversal

themes and curricular programs as knowledge encouragement, citizenship, and preservation of heritage.

New challenges regarding providing innovative experiences to avoid the monotony of classrooms are difficult to address, and providing trans-disciplinary experiences in cultural or public spaces is still hindered in the academy. However, regarding the activities achieved, the participants' broad acceptance and enthusiasm were observed in creating proposals and integrative, critical, and pleasant actions.

Achieving the activities pertaining to scientific investigation alongside peripheral communities and integrating academic research with the community highlighted Volkmer's observations (2005) on creating an environment for dialogue between research, education, and citizenship. When using the city as a facilitator of interaction, a positive strategy was employed wherein urban planning and sustainability focus on producing socially relevant scientific knowledge.

6.1 Results of the Students' Diagnosis

The neighbourhood analysis was based on Kevin Lynch's urban structure elements. To analyse urban landscape factors, the urban readability items proposed by Lynch (1997), which consider paths, districts, edges, nodes, and landmarks, as well as citizenship and sustainability concepts were adopted. An urban route from students' residences to the school was identified to determine improvements and symbolic elements included on this neighbourhood route. Furthermore, it was determined if these elements are related to other spaces in the city. These urban elements were then identified and located on local maps and the city map. For the neighborhood, the students focused on identifying the lot where each one's residence is located, analysing the permeable areas and areas built. Therefore, new methodologies with graphic responses provided through drawings and collages were proposed. The location of the housing unit on the lot of each student's residence was evaluated to verify the existence of permeable or non-permeable areas. The importance of permeable areas on the lot, in the neighbourhood, and in the urban area was analysed. For the implementation of the residence on the lot, the form of its roof was graphically represented and development calculated to verify the built impermeable area, proportion, and relation between two areas, adding concepts and numerical expressions to the work. There was great interest from and personal fulfilment for the students in terms of the challenge of understanding (Fig. 2).

6.2 Results Based on the Urban Proposal Elaborated by Students

After studying themes related to urban insertion and considering the students' urban diagnosis, activities to develop critical thinking and the ability to propose urban and social improvements for their neighborhood were created. After observing the lack of urban equipment and leisure areas in the neighborhood, each student developed a schematic project demonstrating what they wanted their neighborhood to provide. Important elements proposed by the students included parks and squares, sports equipment such as blocks and skating ramps, cultural amenities such as movie theatres and areas for artistic performances, and spaces for life in society such as social tribunes (Fig. 3).

6.3 Instrumentalisation: The University and Community Inclusion

To complete the activities, the two schools were integrated for the activity on the urban route, which involved identifying locations on the maps, and later for the activities at UPF. On-campus activities included a visit to the Zoobotanic Museum

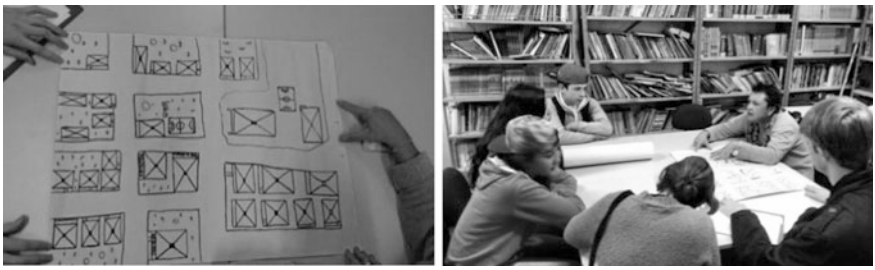

Fig. 2 Formulating maps of the neighbourhood and location of housing units. *Source* The authors

Fig. 3 Students developing maps of the ideal neighbourhood. *Source* The authors

Fig. 4 Visit to UPF. *Source* The authors

to see the museum project and exhibitions such as 'Biodiversity: Preserving Human Beings' and the 'Ecosystems of Brazil' (Fig. 4).

Later, the students visited two computing laboratories at the Faculty of Engineering and Architecture (FEAR), where they were helped by monitors and participated in the SketchUp workshop, which had already been started in schools: 1—To ensure this activity achieved its aims with 30 students from municipal schools, students of the Architecture and Urbanism program were invited to tutor this task. 2—The students and monitors were so excited that the activity was reported on the institution's web page. 3—For this workshop, eight monitors were present to help the students with their learning in the program and to draw a small residence and its surroundings.

6.4 Socialisation: Issues of Citizenship and Popular Participation

The activities developed throughout the research process culminated in the students' visit to the Chamber of Representatives of Passo Fundo city. The visit included an interview with a representative, who spoke about activities initiated by the Chamber of Representatives and importance of popular participation in the management and care of the cities. After the lecture and an interview with the representative on the concepts and students' analyses and diagnosis of each neighbourhood, she invited them to participate in the Popular Tribune, where one teacher and one student of each neighbourhood reported the needs identified by other classmates and representatives (Fig. 5).

Fig. 5 Visit to the Chamber of Representatives. *Source* The authors

6.5 Internationalisation: Sharing Knowledge and Culture

Exchange students from Argentina participated in the development of this research in the second semester. During weekly meetings, exchange students from the Architecture and Urbanism and Civil Engineering courses helped to teach urban concepts and participated in the urban program focusing on the peripheral areas of Passo Fundo city. Enjoying the special participation of the Argentinian students in the work proposed by the project, students in their ninth year at school attended a lecture on 'Argentinian Time', which was presented by the foreign students as a lecture on their country of origin, Argentina. For the lecture, Argentinian students prepared a short presentation on their country, culture, customs, food, games, flag, and of course, sports.

7 Conclusion

This research met the objectives of the public notice to integrate university and primary education. It also met the objectives of the proposal, which focused on increasing the community's awareness of citizenship and the right to the city, as well as their knowledge on urban planning, sustainability, and critical thinking of the process of urban design. Employing the analysis of the urban guidelines provided by the PDDI, a better understanding of public policies pertaining to the peripheral areas of the city was obtained. This made it possible to determine the quality of urban life based on the concept of sustainability and potential issues regarding the use of a sustainable urban infrastructure. For students in the fundamental school involved in this urban instrumentalisation and investigation process, there was a significant evolution in the development of citizens able to act to achieve their community needs. For academic students, community living alerted them to the real needs an urban project must consider, taking into account the principles of sustainability and citizenship.

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Live-Long Learning as a Sustainability Strategy

Christopher A. Haines

Abstract If I could snap my fingers and reverse all the environmental damage of the past 5000 years, we would start repeating our mistakes tomorrow, unless WE have changed. In the age of the Anthropocene, it is human thinking and the decisions and actions that follow from it that will determine our fate as well as that of many other species. While many of our 'solutions' have worked to some degree in the short term, where a human lifetime is 'short term', our thinking has frequently prevented us from fully understanding the extremely complex systems we live within, and thus from fully addressing those complexities or avoiding the many unintended consequences we create. A sustainable future thus requires a mental perspective compatible with the parameters of, instead of attempting to dominate, the world we inhabit. Split brain science provides the key to that perspective, explaining the human brain and how the problems we have created have resulted from our misunderstanding of its basic structure. As the world population expands, pressuring us to achieve a sustainable future within an urban context, while we know some, we do not yet know all the changes we will be required to make to society and our built environment. This paper will explore why we need to start with understanding ourselves and our thinking and then how we must transform that into an attitude of live-long learning to progressively grow our knowledge and expand our capabilities to regenerate society and our built environment.

Keywords Split brain science · Sustainability · Climate change
Biodiversity · Small water cycle · Urban design · Healthy cities
Life-long learning · Renaissance man

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1 Introduction

> If I ever find a problem I cannot solve, I make it bigger. I will never solve it by trying to make it smaller, but if I make it big enough, I will eventually find the outline of its solution.
>
> Dwight D. Eisenhower

Many who have looked deeply into our ecological condition recognize that while the proposed solution of greenhouse emission reductions is not wrong, it is incomplete (Kravcik et al. 2008; Kravcik 2017; Outwater 1996; Schwartz 2013, 2016; White 2014). Greenhouse emissions increase the energy load on the planet. They do not in themselves determine the result of that increased energy load. Yes, we need to reduce emissions, but we have disrupted numerous ecological cycles; the carbon cycle and the resultant increase in CO_2 in the atmosphere being only one of them. In order to stabilize the 'web of life' (Storer 1953) on which all life on this planet depends, we need to re-establish an ecological equilibrium that will continue to support these cycles. The growing body of research on civilization decline notes ecological destruction as one of the prime reasons for past societies failure (Montgomery 2008; Ophuls 2012; Ponting 1991; Ward-Perkins 2005).

This requires us to develop a civilization that can exist within the parameters of the ecological cycles that we have here-to-fore sorely misunderstood and largely ignored. The trajectory of western culture towards science and technology as the source of all solutions is moving us further from a mental equilibrium required to create an ecological equilibrium (McGilchrist 2009; Ralston-Saul 1992). Thus fully understanding our thinking and re-establishing a balance in our thought processes becomes the critical element in moving towards a sustainable future.

Several years ago I published a simple concept I referred to as the "six environmental crises' (Haines 2011). The point was merely that if we resolved excessive greenhouse emissions tomorrow, we still have at least five other categories of problems that will haunt civilization until we address them as well. The six crises I noted are: population, resource depletion, environmental destruction, pollution, climate change and human paradigms. In this grouping, climate change as caused by greenhouse emissions is actually only one type of air pollution, however, it seemed worthy of its own category. I will not argue that this is a perfect system and others may have better configurations, but the point still stands that we have other problems besides greenhouse gases. This paper will explore why we need to start with understanding ourselves and our thinking and then how we must transform that into an attitude of live-long learning to address the human paradigms that are ultimately the cause of all our ecological problems, and many others as well.

This analysis immediately challenges our perceptions on at least two levels. On the first level, we clearly need to change our self-image from one of master to one of student. This is not uncommon in many indigenous cultures in history and around the world, but it is not the way the western traditions have seen themselves and it may strike us as primitive and self-demeaning. Yet, we must accept that the situation we

find ourselves in is of our own making and we need to look farther afield for real solutions. This includes understanding and questioning the assumptions and thinking patterns that have gotten us here and being willing to admit that there may be alternatives, even if they seem to violate our best judgements.

On the second level, while we pay lip-service to "Renaissance Man", westerners have an undying devotion to specialization, science and rational thinking. These approaches seek facts by division and isolation and ignore context and relationships which are critical in life and ecological settings. They also come with a variety of mental baggage that we fail to recognize or understand. The reality that the real problems are at least as wide as they are deep challenges our belief in science and progress as the routes to knowledge. There are very real reasons we think this way, and they are not all wrong, but like our understanding of climate change they are incomplete. This paper addresses this problem from a generalist "Renaissance" perspective, integrating a wide, but still incomplete range of material that must be included if real solutions for the continuation of human society on this planet are to be found.

2 The Human Brain

I am not a psychologist or neurologist, but a layman student of sustainability who recognized that our thinking is at the heart of our problems. While I have read extensively on the subject, I do not claim to be an expert. An expert would require more space to explain the nuances and dangers of over-simplifications that I am forced to make than the entire length of this article. I will largely stick to key points to provide an introduction to how this material impacts sustainability and life-long learning that is the topic of this paper.

The human brain is an extremely complicated and remarkable organ. One of the first issues is that we assume that a detached, scientific process is required to reveal its operations and that with enough of that work we will finally have all we need to understand the parts that we believe make up the whole. That is after all what the scientific process is; a series of thesis and tests of those theses until we build an understanding of the true nature of the problem.

Unfortunately, this has not led to the outcome we hoped for. While a very large number of specialists have been involved in this research, what we have to show for it is a very large amount of, largely conflicting data that the researchers seem unable to draw conclusions from (Gazzaniga 2015; Haidt 2012; Ledoux 1996, 2002 and others). This is not to say we have not learned anything, we have, but as each specialist has confined their work within their specialty, very little that sits between those specialties is illuminated. This result is actually of great importance and if we can shed our self-imposed blinders, explains a great deal about the human brain.

The human brain, like that of most species is divided into two hemispheres. The right hemisphere is connected to the outside world by its use of sensory organs that inform it of goings on around it. We can think of this as based on the evolutionary need of not becoming dinner for a predator. A failure to recognize oncoming

dangers greatly limits progeny. In the context of observing what is arounds us, the right hemisphere is also the basis of connections to and relationships with other people via empathy, sympathy and compassion and is the seat of our moral compass. The right hemisphere is also the basis of imagery, visualization and creative, three dimensional thinking. However, the right hemisphere is largely non-verbal and for a long time was considered the 'minor hemisphere'.

The left hemisphere is the source of speech, logic and reason and has thus been considered the basis of intelligence. Yet it is self-contained and "A closed system which cannot reach outside itself to whatever it is that exists apart from itself," (McGilchrist 2009: 330). As a corollary to the right hemisphere's focus on self-protection, the left hemisphere is concerned with finding dinner. Its' focus is on utilitarian and concrete ends, that it pursues with abstract (closed system) reasoning and linear thinking. It seeks power and control, values its own creations, dismisses that which it cannot understand or control and is excessively optimistic of its capabilities. Thus the two hemispheres play very different roles, but in theory humans balance the use of both sides of their brain in normal circumstances.

This is an important point. As we discuss the right and left hemispheres as independent entities, we need to remember that these parts of the brain reside within a single person. While the left hemisphere may be incapable of empathy that does not mean that the individual is incapable of empathy, unless they allow their left hemisphere to dominate their thinking and actions. Some do. While the scientific method is effectively a left hemisphere process, and this has impacted split brain research, this does not mean that scientists are incapable of bridging that gap. Great scientists have routinely used their right hemispheres to augment their left hemisphere thinking and frequently have been the ones to come forth with great discoveries and understanding. To the extent that an individual allows the thinking pattern of one hemisphere or the other to dominate their perspective they may become representative of that hemisphere's perspective but they have the choice to widen their thinking and access the perspective of their other hemisphere. The one caveat is that the reasoning capabilities of the left hemisphere are very seductive and we have been seduced by logic and science as the sole source of knowledge. We either ignore the idea of wisdom or subsume it below knowledge. Thus, we as a society have become more and more left hemisphere dominated in our approach to the world, (McGilchrist 2009) and this has significant implications in our relationships with nature and society at large.

As you may recognize, one of the problems with scientific research into the brain, is that the process of scientific study is largely left brained. One of the reasons that science; this is not the same as scientists, has had such a hard time understanding the two hemispheres is that their very methods dismiss the relevance of right hemisphere thinking. Science has for many years been asking "what do the two hemispheres do? This is a left hemisphere question. Research came up with data showing that both hemispheres were involved in almost every brain operation. It was not until the question was rephrased into "in what manner do the two hemispheres do what they do", that significant differences between the hemispheres became evident.

3 The Two Hemispheres

New information is taken in by the senses through the right hemisphere with all the context, details and special features of a unique event, object or person. When this information is no longer 'new' but 'known', it is passed to the left hemisphere where it is stripped of its context, generalized, abstracted and arranged into categories for retrieval. Because the left hemisphere is isolated from the outside world everything it knows is its own creation, driven by internal logic more than outside evidence. To the right hemisphere, Joan is a special friend or neighbor with unique qualities and important connections. To the left hemisphere Joan is no longer unique, but generalized as a woman, a person or whatever category she might fit into.

This is the brain whose job it is to obtain dinner, utilitarian, and valuing things only in terms of its own wants or needs. In the paleontological context this would include obtaining food, building shelter, perhaps securing materials for clothing and other physical necessities of life. However, the left hemisphere is unable to relate to people because it has no means of getting outside of itself to connect with something (someone) apart from itself. It is the right hemisphere's sensory and emotional connections to the outside world that are the source of these relationships through empathy, sympathy and moral concerns. Because these connections can recognize a shared loss, they may appear melancholy, but being based on experience they actually reflect reality far more than the overt optimism of the left hemisphere.

The left hemisphere is concerned with what it can control and it dismisses as unimportant that which it cannot understand or control. "Magic is the way that the left hemisphere sees powers over which it has no control." (McGilchrist 2009: 311). Control may take the form of technological control or superiority over nature, physical or political control over people, bureaucratic control over systems or academic control over thinking. Thus the left hemisphere takes great pride in its own creations, exemplified by a long history of technological creations, particularly for war and the subjugation of others. Our western Judeo-Christian tradition of the domination of nature is the calling card of the left hemisphere. The 'Go forth and multiply' is another form of power and control.

The left hemisphere is focused on defining parts which are organized into categories. Its process is dissective, creating parts that are interchangeable with similar parts but without the capacity to interact, or to influence the characteristics of the whole, thus dead. Without synergy between parts the whole can never be more than the sum of those parts and can never 'live'. We are thus hardwired for Frankenstein, zombies and robots. While we know the Frankenstein story, the origins of that story go much farther back into history, representing a long held human illusion. Robots are so seductive because they come closer to life than anything we have ever created as they can move, talk and even learn, with mechanical components and an energy source.

The left hemisphere is probably its most seductive as the source of speech, logic and reason; considered the basis of intelligence. (Why would it be that we consider these qualities the most important?) It is certainly true that we would be a very

different world is we could not speak and communicate with others. We would also be a very different world if we could not reason. Ever since Plato's abstracted truth with reason being the path to that truth, we have strived to achieve that promise. The western tradition has certainly glorified the Enlightenment and the "Age of Reason" as the epitome of progress and culture.

While these abilities are certainly important and their use has resolved many problems the human species has faced, they are limited by the left hemisphere's pursuit of understanding by linear thinking. Our ecological home is not a linear system which avails itself of simple cause and effect analysis. It is an extremely complex system of inter-related feedback loops almost completely opaque to this left hemisphere analysis. Our creation of mental models that are far from the mark of reality is a result of the limits of our left hemispheres functioning. Donella Meadows (2008) made an important contribution to this issue with her "Thinking in Systems" but we still regularly fail to properly evaluate, much less correctly address the conundrums we face in ecological systems. Indeed, historians have identified our inability to resolve complexity as among the critical causes of civilization decline (Ophuls 2012).

The left brain is also strongly goal oriented and overly optimistic of its abilities. The Green revolution was an attempt to feed the world by using vast quantities of petroleum energy to augment traditional agricultural practices. Feeding the world is certainly a laudable goal, but the single minded focus of left hemisphere thinking excludes "anything it cannot understand or control" and this unfortunately includes all the natural laws that govern the biology of soil and life. Thus we defaulted to simple relationships between a few chemical additives and the results they could produce. Faced with a continuation of a need for food we are quite undeterred by our failure. The left hemisphere has an almost unlimited ability to deny evidence contrary to its intent, but also to gleefully declare that we have merely not gone far enough on the chosen path to achieve success.

4 Ecology and the Brain

> Wise men say, and not without reason, that whoever wishes to foresee the future must consult the past: for human events ever resemble those of preceding times. This arises from the fact that they are produced by men who ever have been, and ever will be, animated by the same passions, and thus they necessarily have the same results.
>
> Niccolo´ Machiavelli

The left hemispheres use of generalized abstractions for utilitarian ends, with a goal of achieving power and control, with a lack of empathy for people and an inability to appreciate beauty, focused on parts, working within a process of linear thinking and pursued with excessive confidence are not highly consistent with co-habiting within the natural world. This is after-all, the brain intent in finding dinner and within these paleontological ends, this is an understandable process. It is just that these same traits have very different results in a highly technological and

rapidly changing society in the age of the Anthropocene. Our ability to inflict damage on the natural world has increased dramatically with our leverage of external energy sources and confidence that we can solve any problem with science, engineering and technology. Let us consider these aspects of left hemisphere thinking with their implications for our current situation.

The isolated, internal aspects of left hemisphere thinking mean that the information the left hemisphere uses for understanding the outside world is material of its own making. New information is noted by the right hemisphere, but once that material is 'known' it is passed onto the left hemisphere. While music is very much a right hemisphere art, professional musicians work with their left hemisphere, while the rest of us must use our right. Thus, in order to remain vigilant of the natural environment, we much keep our right hemisphere observing or we will slip into seeing what we expect to see, instead of what is really there. What we expect to see is based on trajectories from the past, thus we start to fail when the present veers from those trajectories. Our brain is built for stability and does poorly in anticipating change.

The left hemisphere is concerned with parts and its practice is to dissect parts into ever smaller components. This has surely been the basis behind the discoveries of atoms, electrons and quarks. But it has also created our silos in academia and justified the deep specialization of professions. It is true that there is much more information today than there was even a few decades ago, but specialization is a poor vantage from which to try to build an understanding of the natural world. When your tool is a hammer, everything looks like a nail. The attempt at inter-departmental and trans-departmental teams is a left hemisphere attempt to compensate for its own limitations. What may really be needed is a re-evaluation of our thinking failures and a recognition of Einstein's truth that "you cannot solve a problem with the same level of thinking that created it". We have not only lost the Renaissance man perspective, but no longer even value it (McGilchrist 2009: 312). McGilchrist sees this as an intentional power grab on the part of the left hemisphere (2009: 386).

The left hemisphere's ends are utilitarian and concrete, with the ulterior motive is gaining power and control in whatever form that may take. While many people will say that humans are hardwired for greed; and this is surely a part of that issue, as you can see it really goes farther than that. As the world becomes more divided by specializations, individuals work within smaller and smaller circles of control. Thus each becomes more and more concerned with control within their circle and society becomes clusters of fiefdoms, whether in business, politics or academia.

The utilitarian ends leave the left hemisphere without the capacity to appreciate beauty, be struck by awe, or to find value in something outside of its direct use to itself. While the right hemisphere may see a wonderful forest, gorgeous waterfall or magnificent mountain, the left hemisphere sees only timber in need of harvesting, power for a mill or maybe an obstacle to river travel and the future site of a mine. As an isolated and unaffected bystander, the left hemisphere will never come to the defense of natural systems for their own sake. Left hemisphere dominated thinkers may participate in ecologically beneficial projects, but will do so only when

convinced that it is in their best interest and frequently that is measured in economic terms. If those interests diverge in the future that individual will go with their own self-interests.

The second part of this is that the left hemisphere "dismisses as unimportant that which it cannot control". This is not insignificant. An issue outside of control is not only, not focused on, but is viewed as unimportant. While a scientist may control the research he/she is running, they cannot control the implementation of that research to solve the problem they are learning about. Thus society can gain information from science about problems, but the same thinking cannot solve those problems. The result is that the big issues, outside of the control of almost every individual or group, can be ignored as unimportant. I cannot help but believe that this thinking is responsible at least in part for climate denial.

A perspective of the whole as merely "the-sum-of-the-parts" is unable to comprehend the miracle of life. The left hemisphere's linear thinking cannot unravel life processes. While linear thinking can be extremely useful, the interrelationships within living soil or the process of decay with the millions of life forms that work together to return a once living organism back to the ecology are well beyond its abilities. These interactions number in the millions and the feedback loops occur in nearly infinite iterations. Thus man's dominant thinking pattern and that which we pride ourselves on as intelligence is completely unable to create an abstraction that correctly represents the world we inhabit. It is no wonder we have a real problem with understanding the ecology. Our designs "unintended consequences" represent the places where our thinking has failed to reflect the true world and it comes back to remind us of our errors.

The impact of reason on our current predicament lies in its successes, its limitations and its baggage. Linear logic is a powerful tool that has helped to build scientific knowledge slowly over centuries. As we are seduced by logic's promise we become overconfident with more complex problems. Faced with the reality of the world, linear thinking is incapable of success. We have created complex computer programs, "big data" and consumed a great deal of energy to analyze and seek solutions. (The left hemisphere also cannot trust, so there is never "enough" data). Surely we have made progress; however, perhaps we need a different perspective more than more data. The reality that the left hemisphere's reason is paired with a lack of empathy, concrete utilitarian ends and a focus on power and control diminishes its benefit but explains much.

The overly optimistic nature of left hemisphere perspective is also significant. The right hemisphere is often seen as pessimistic. However, everything the right hemisphere knows is based on experience which includes its bumps as well as its successes, thus the right hemisphere is in fact more realistic than the left. The right hemisphere also feels empathy for others involved and experiences their pain as well as their joy. The left hemisphere on the other hand, is working only from theory, un-filtered by reality and thus can be totally unreasonable and over-confident even in cases where it has little to no chance of success.

To reiterate, this is not a condemnation of scientists, who have in many cases overcome or at least partially overcome these failings, by integrating the use of both

hemispheres of their brain to access the multi-spatial, relational and qualitative abilities of right hemisphere thinking. While society has focused on STEM education as our solution to the problems we face we have failed to recognize that without our right hemisphere's contribution, math, science, engineering and technology fail on their own terms (McGilchrist 2009: 434). It is only with the contribution of the arts and the right hemisphere that these technical abilities have any chance of improving our condition. It was a flowering of the right hemisphere that created the Renaissance and the belief in a "Renaissance Man" with the integration of all knowledge (McGilchrist 2009). As our society is more and more convinced of the useless nature of the arts; and McGilchrist (2009) argues that this is intentional by the left hemisphere, we are placing ourselves in greater and greater danger, undermining the very thinking we most need to realistically understand and address our most pressing ecological problems. *"We need the ability to make fine discriminations, and to use reason appropriately (left brain science). But these contributions need to be made in the service of something else, that only the right hemisphere (the master) can bring.* ***Alone they are destructive*** *(emphasis added). And right now they may be bringing us close to forfeiting the civilization they helped to create."* (McGilchrist 2009: 93)

5 Sustainability and Urbanism

I will posit that sustainability is living within the parameters of the planet's natural systems. We need to stop doing harm, but also repair the harm we have already done. Repeating our mistakes will only produce more of what we have. Therefore, we must start with understanding and correcting our thinking. There are places where our left hemisphere can be a great aid, but we must not be seduced by its hubris and optimism, nor allow a power hungry and uncaring attitude to persuade our actions. We need instead to take the perspective of student, to observe and question as indigenous cultures have done for millennia, building a holistic understanding of the environs we inhabit in all its complexity, seeking wisdom over knowledge. This requires an integration of our thinking and cannot be achieved solely with the left hemisphere and technology.

The open-ended nature of this process is the point of the thesis of life-long learning. We know that we have been emitting more greenhouse gasses than we can afford and that the carbon cycle is not the only cycle we have disrupted (Kravcik et al. 2008; Kravcik 2017; Outwater 1996; Schwartz 2013, 2016; White 2014). So while we need to reduce greenhouse emission, we also need to address the other environmental crises we've noted. Yet we do not truly understand all of those parameters and have little way of defining how to live within them. Thus we need to take the actions that we know while we determine what additional changes are needed in how we inhabit this world.

The experts seem to agree that we will be living in urban settings to a greater extent in the coming years. Thus our solutions to life on this planet will have to be

developed in an urban context. Many see great benefits in this because urban dwellers generally consume less and emit fewer greenhouse gases on a per capita basis. However true, that is only a partial review of the realities of urban dwellers.

Cities come with an uninspiring history of failure (Ophuls 2012). To become part of the solution, urban centers need to operate as contributing entities and not as parasites on surrounding areas. Perhaps we need to start thinking completely differently about cities (Todd and Todd 1993). We need to address regenerative design through such standards as the Living Building and Living Community Challenges (living-future.org) which challenges us to build without toxic materials while still achieving net positive energy, water and waste, drastically improving health and indoor air quality while addressing social equity, biodiversity and related issues.

We need to utilize land use planning and regional design (Calthorpe 2011) to its greatest benefit, address heat islands (Garland 2011), and renovate existing buildings, suburbs and towns into sustainable healthy cities. Food and urban agriculture need to be integrated into this city design (Cockrall-King 2012). Cities have been excessively polluted in much of the past and air quality and health needs to be addressed especially to the extent that we continue to use internal combustion engines for transportation. Cities most important impact may be on the small water cycle; discussed below, which will require drastic changes in our thinking and operations, but whose resolution will further reduce heat islands and could reverse climate change (Kravcik et al. 2008; Kravcik 2017). Healthy and sustainable cities will require the diverse, innovative and lively communities depicted by Jane Jacobs (1961) and a resolution of the sociology at the heart of much of our current societal and political gridlock (Dunkelman 2014). Maybe we can even recapture the belief of the French Enlightenment that the purpose of progress is ‘happiness’ and promote the well-being of society (Haines 2013).

6 Life Long Learning

Thus we need to create the most sustainable living conditions we can, perhaps like the pioneers of the 1970s making first attempts at low energy buildings, live in the built environment we have, continually reevaluate our condition based on what we learn and then rebuild, repair or upgrade our environment to the level of our new knowledge. Rinse, Repeat.

The first step in this process is to better understand our own thinking and to catch ourselves where we have been seduced by logic that is flawed in its intentions. As an example, most of the world accepts geothermal energy as environmentally benign. I see it as another form of mining. We are well aware of the unsustainable nature of extraction (Bardi 2013). In theory, in geothermal processes, heat is removed while needed and returned to the earth when excess is available, producing a net zero result. Nice theory. For a variety of reasons projects very rarely achieve that. Thus we have accepted a process that is mining heat instead of ore or fuel. If that means that with time, we could actually cool the planet, we are on a path with a

staggering downside. Yes, I have heard geologists talk about the quantity of heat in the earth; it is a staggering number and it would take many years, maybe generations to make any difference at all. That misses the point. It is finite, so processes that remove heat do have an impact even if we may not see that impact for many generations. We did not see the impact of greenhouse emissions for 100 years or more before we became concerned about it.

Secondly, we need to take a more holistic view of our interactions with the environment. We know we need to reduce greenhouse emissions and have noted five other environmental crises. What do we need to change to address these issues and what impact will it have on human society, other species and the earth as a whole? What are the other major cycles we have disrupted?

There are two that stand out, but they are surely only the tip of the iceberg. Number one, we have disrupted soil. The thin living soil membrane over the land area of the planet is the source of life for most of the human and non-human population. We accept agricultural practices that promote erosion and industrial agriculture hastens this decline. We seem willing to overlook the fact that erosion has been the downfall of many civilizations in the past by insidious actions that fail to produce human reactions until it is far too late (Montgomery 2008). Even faced with the historic occurrence of massive gullies left by erosion's toll, societies have failed to take significant measures to reverse the decline. The great agricultural soils of the western US were some of the richest and deepest on the planet. While they still produce due to the enormous capacity we started with, they have been severely depleted by industrial agriculture. The last wake-up call on erosion in the US was back in the "great dustbowl" but that has sufficiently faded from society's memory that it no longer holds much sway on public opinion.

Related to our willingness to allow erosion is our misunderstanding of soils highly complex living structure. Our society treats living soil as a dead mass of dirt and we have thus transformed the one into the other. By treating soil as a dead entity into which chemicals are poured, we have created a dead entity that is nearly incapable of producing crops without increasing amounts of those hazardous chemicals and all the related chemical used to address the problems of a dead soil. We accept the necessity of this practice to such an extent we seem willing to accept toxic food and the destruction of natural pollination systems before we see a need to reign in the profits of the chemical producers.

While we focus on greenhouse emissions as the total cause of Climate Change, we overlook the part that soil could play in reversing those emissions. That role is only beginning to be understood, (Schwartz 2013; White 2014). In effect, all the CO_2 in the atmosphere was once in the soil and proper living soil would return that carbon to itself, if we would stop killing the life in it with chemicals unsuited to soil processes and other living things. A soil with higher carbon content would also absorb a far greater amount of water, making it more resistant to draught, floods and erosion.

This leads to our misunderstanding and disruption of water and small water cycles; the vertical circulation cycles that operate on the regional scale within the boundaries of geological areas, a river basin or other geological region that divides

its air and moisture currents off from neighboring regions. By sluicing away "wastewater" and land use practices that cause drying, we are reducing the amount of water in the regional water cycle (Kravcik et al. 2008; Kravcik 2017). Urban centers with great expanses of impervious surfaces have a large impact on this. The drying out of the land, desertification and flooding are the result of this reduction of water in the system. Mankind has been making these same mistakes for centuries as the historic centers of human civilization are now mostly deserts, or rapidly becoming so.

Twenty two authors have concluded *"The substantial body of research we review reveals that forest, water and energy interactions provide the foundations for carbon storage, for cooling terrestrial surfaces and for distributing water resources. Forests and trees must be recognized as prime regulators within the water, energy and carbon cycles."*(Ellison et al. 2017) And Kravcik notes *"While scientific publications…emphasize the impacts of global warming on the circulation of water in nature, almost all of them are totally silent on the influence the water cycle has on climate change"* (2008: 87). This is explainable with basic physics. Global warming is the increase in the earth's temperature; yes, climate change is more complex. The emission of greenhouse gases produces an increased energy load by reflecting more solar radiation back into the earth's atmosphere. With dry conditions, an increasing energy load produces sensible heat, an increase in temperature. Yet, with moist conditions, an increase in energy input produces increased latent heat, (increased moisture) but without a temperature rise. Thus, by managing water, we can mitigate if not reverse the increase in the earth's temperature, even with higher atmospheric CO_2 levels.

Secondly, global warming is blamed for sea level rise from melted ice and by expanding the ocean's volume by raising temperatures. This is true as far as it goes. However, rivers run into the oceans and unless that water is returned to the land (the large water cycle) the rivers are the number one reason for the increase in the volume of the oceans. Practices that increase the amount of water going to the oceans is thus one cause of sea level rise. If rainwater remained where it fell, and soaked into the soils it could recharge groundwater instead of increasing sea levels. An increase in soil carbon would increase water absorption capacities. The IPCC report documents sea level rising faster than calculated on the eastern US Atlantic coast. Rough calculations indicate the loss of water from the soil of the eastern seaboard is equal to approximately the missing one and a half inches of sea level rise (Jehne 2015). The drying out of land also increases the prevalence of the large water cycle producing severe storms. Thus poor water practices are increasing the severity of storms, as seen in recent years.

While the agricultural changes indicated by the carbon cycle in soils would have little bearing on cities directly, it would have a significant impact on our agricultural health and overall societal health and security. The water cycle issues bear directly on urban design in that our fixation with "waste water" would have to be completely reversed. Collecting rainwater off impermeable surfaces and thus preventing it from soaking into the soil where it lands has a significant bearing on the water table of the region and ultimately on the region's climate.

These are only a few of the issues that society has to deal with in life-long learning for a sustainable urban future. If we could re-design our urban built environment to work within these parameters, we would have made a significant improvement. We would not however have solved all our problems, only in part because we do not yet know what they all are. Thus life-long learning will be the essential ingredient in our ongoing process of seeking a sustainable society.

7 Conclusion

This paper has addressed the critical issue of the human brain and how its structure impacts our thinking, our understanding and our worldview and related this material to life-long-learning for the creation of a sustainable urban society. By addressing so many topics I cannot be an expert on, the material is by definition oversimplified and incomplete. By addressing topics so many others have written tomes on, it is necessarily overly abbreviated. I take full responsibility for those choices. I accept these shortcomings because I am clear that the dominant, left brain, specialist, expert perspective has created the situation we find ourselves in. As Einstein said, we need to find a new "level" of thinking to solve these problems. This "new level" is an integration that accepts the value of the left brain without the "dictatorship" of the left brain. We need a new 'flowering' of integrated thinking to rise above our ecological predicament. The understanding provided by split-brain science provides the guide we need to begin this journey.

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Young People's Role in Creating Sustainable Cities

Chris Willmore, James Longhurst, William Clayton, Hannah Tweddell and Amy Walsh

Abstract This chapter considers the role of young people in developing and sustaining resilient sustainable infrastructure in cities. Discussions can often focus upon physical infrastructure, with less focus on human infrastructure, and when the latter is considered it is often in terms of families and geographical networks. Young people's networks are often more mobile, less geographically specific, but provide strong, innovative communities in which norms and preferences are being tested and set. Engagement with young adults offers a productive opportunity for learning and for transformations in relation to the resilience of the wider community and the individual's resilience. This chapter draws upon the award-winning Bristol Green Capital: Student Capital research data, the Bristol Learning City project and wellbeing and relational thinking literature to explore the relationships between SDG 4 learning, engaged activity and wellbeing, the significance of partnerships (SDG17) as an outcome in its own right and argues that the capacity of young people to play a change agent role in developing city sustainability (SDG11) is undervalued.

Keywords Young people · Sustainable cities · University · Partnership Change agent

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1 Introduction

What makes a sustainable city? The first thought is usually about physical infrastructure, whether transport, energy or green spaces. The second is often about wellbeing. When running workshops to help academic staff explore the concept of sustainable development, we sometimes ask them to draw a sustainable and unsustainable city. That is precisely what they draw—a contrast between happy families with green spaces and good transport and unhappy people with pollution and no greenery. When young people do feature, it is usually as children in those happy families. Young adults are seldom visible.

When we look at international policy instruments, the same picture emerges. Young people are generally invisible, and where visible are problematized as needing something. This is not always the case, UNESCO for example through the International Coalition of Inclusive and Sustainable Cities (ICCAR 2017) is increasingly identifying the transformative opportunities of youth-led civil society action.[1] But such examples are exceptions.

Ban Ki-moon as UN Secretary-General tried to address this imbalance in his speech on International Youth day in 2007: "It is high time that we stopped viewing our young people as part of the problem and started cultivating their promise and potential…" (Ki-Moon 2007)

But even this positive statement positions young people as having something they might contribute *in the future*. This chapter looks at the transformative role young people can play whilst they are young people and specifically *because* they are young people, who see the world differently and have a different place in power hierarchies from older people.

This contribution gap is exacerbated by the lack of data about young people. The OECD for example distinguishes between under 15 s and the working-age population. Young adults 18–25 are invisible: subsumed in working population, unemployed or student figures without age distinction. Eurostat draws the line at 19, giving data for 0–19 and 20+ (Eurostat 2013), as does the Office for National Statistics in the UK (ONS 2017), so no agency gathers data on the 18–25 year old cohort. Yet in developed nations this is the age range in which most commonly people are becoming independent, developing the habits, practices and lifestyles that will inform the rest of their lives. They are at once both elusive because of their mobility and freest to engage in new ideas and activities.

Globally, people aged 14–24 now form almost a fifth of the world's population (United Nations 2015), although in the EU the figure is lower at just over 11% of the EU (Eurostat 2017), and 12.4% in the UK (Eurostat 2017). In cities the percentage of people in the 18–25 age group is higher.[2] This is a significant sub-set of

[1]Elza Sefarian's advocacy of the role of young people in Lebanon at Habitat III (United Nations 2016).

[2]See for example the role of young people in Africa's urbanization (Hope 1998).

the population, and one that this chapter argues to have particular characteristics that make them potentially key players in city transformation.

Young people are often problematised in a community. They are seldom the focus of positive attention, and when they are considered it is as objects in need of services or support, not as contributors to the community. They are seen as transient, difficult to reach and disengaged. Initiatives do exist which focus upon the needs of young people in cities, for example Plan International's initiative on Safer cities for Girls in Kenya (Plan International 2017),[3] but there is a risk that young people are seen as one of the challenges of urbanisation, and that we do not see how they are also part of the solution. The picture is not uniformly negative. Wealthier post-university young people for example are seen in the media as driving the renaissance of city centres (Thomas et al. 2015), but there is no consistent approach to the wider cohort of young people.

This chapter starts from a different perspective. It looks as the role of students in building healthy, sustainable cities. Students as a whole are a good example of the problematization of young people. They are often criticised for driving up local property prices, distorting the local economy, parking cars inappropriately, and generating noise, waste and other pollution. Cities find it hard to engage with them, as they do not operate in the conventional networks driving cities, which are strongly locality based. And importantly, they are seen as transient: only residents for the duration of their studies.

We can calculate how many 'students' there are in any geographical area, and the percentage of the population they form. We can do this for any cohort of students—for example distinguishing those at higher education institutions, those at further education institutions, those taking particular forms of qualifications—mining the rich resource of Higher Education Statistics Agency data for the UK. So we know who they are statistically. In most cities in the UK that have more than one university over 10% of the population are higher education students. In some cases the percentage is even higher, for example in Cambridge almost 25% of the population were 16–24 in 2009, predominantly students (Cambridgeshire County Council 2011). That is a very large percentage of the population to dismiss as 'transient'. The individual students are of course transient, but that figure is not. There is always that 10% or more of the population who are students. Would we dismiss any other 10% of the population? And this 10% is unique. The University is able to contact them all digitally (and is there any other 10% of the population for which the same could be said?) The University knows where they live, where they study, when they study, and what they study. This is the most documented 10% of the population. And the transitory nature of the individuals within that cohort can be overcome by fostering relationships with the cohort as-a-whole, and with the institutions that are used to working with the transitory nature of the individuals within the cohorts—Universities and Student Unions.

[3] https://unhabitat.org/plan-international-launch-safer-cities-for-girls-programme.

This group is particularly attractive to those constructing city transformation, for two reasons. Firstly, they have energy, time and an interest in discovering new things about themselves and the world. But second, they have a whole lifetime of planetary footprint ahead of them. The patterns of urban living they develop whilst students will have an impact far into the future. If Universities, Student Unions and cities work together to enable students to develop positive patterns of living, as both habits and normative conduct, they will take that with them into other cities as they move around the world. So even if students had nothing to give, investment in this cohort at the very point they are working out what their lifestyle will be is crucial. But students also *do* have a lot to give. They see the world differently to the more traditionally engaged older cohorts because of their youth. They are not tied into the power structures that become more influential as we progress through life. For reasons that are not entirely clear, a century ago, people in the 18–23 age range were seen as leaders—on battle fields across the world, responsible for the lives of their men. To take a UK example, when Guy Gibson was appointed to form and lead the squadron of the Royal Air Force to carry out the innovative dambuster raids he was just 23. Today we are more likely to suggest to a 23 year old that they 'help us by doing a bit of stewarding at an event'. Yet that is to miss out on the key notion that young people see things differently. Imagine a child and elderly grandmother. When mother asks, where we would like to go for a Sunday outing, grandmother would ask 'are we taking the car?' She came from a pre-car world. She had two maps in her mind, where you can go with the car, and the older map of where she went without it. The child cannot remember the non-car world. So the child's map is different, it integrates both. The older we are, the more likely we are to have that multi-layered map of the world, whereas young people have a single integrated map of the world as it is now, not as it was. That enables them to have different visions about where it might go and how to get there. At the very least it gives them a better picture of how it is now, rather than how it was.

2 The Centrality of Partnerships and Relationships

The notion of participatory modes of action has formed part of the sustainability agenda since Rio. Its latest incarnation in governmental instruments is in the UN Sustainable Development Goals (SDGs). These place 'partnership' as the final SDG, alongside 16 physical outcome goals. All of the other SDGs are about things, health, climate change, education, equality and so on. Only Goal 17 is about how we do things. Crucially that articulates the centrality of relationships—that partnerships are a goal in and of themselves, not merely a means to a goal. If we want to develop more sustainable cities, we need to build partnerships. And by that we mean *relationships,* not merely institutional formal 'partnerships'. The creation of partnerships is an aim not a tool.

McGilchrist goes further and argues that 'the kind of attention we pay actually alters the world' (McGilchrist 2009: 5). He is saying that if we do not pay attention

to relationships and partnerships we will not foster them. They require conscious attention. Reflecting Bateson's view (Bateson 1972) that we suffer from an 'epistemological error', Sterling argues that our cognitive map is flawed (Sterling 2003). Sterling draws on McGilchrist's diagnosis to argue that we need to focus upon 'an essentially relational worldview and episteme that is in tune with reality: a worldview that is participative, holistic, systemic, ecological and in one' (Sterling 2012: 514).

However it is not any type of relationship that is needed. 'this entails a conscious shift of emphasis from relationships largely based on separation, control, manipulation, individualism and excessive competition towards those based on participation, appreciation, self-organisation, equity, justice, sufficiency and community' (Sterling 2007: 63).

Taking this thinking a step further, Sterling quotes Elgin (Sterling 2001: 49), that: 'If everything is intimately interconnected, then the quality and integrity of all kinds of relationships are of paramount concern' (Elgin and leDrew 1997: 4).

This is not a rejection of systems thinking, it is about ensuring that we do not focus solely on 'hard systems'. Sterling calls this value integrated approach 'whole systems thinking', or an 'ecosystemic approach' (Sterling 2005; Schluter and Lee 1993), to distinguish it from the uses of systems thinking which are limited and constrained.

Others have arrived at similar conclusions through different lines of thinking, for example articulated through notions of relational thinking both as a movement,[4] and as a language of analysis. For example, Jones (Jones 2009) describes relational thinking as 'insisting on an open-ended, mobile, networked, and actor-centred geographic becoming'. The sort of articulation Jones makes is crucial to the argument in this chapter—and in particular to our understanding of the engagement of young people in building sustainable cities.

This has yet to fully permeate thinking about sustainability projects, at least amongst some funders. In evaluating activities 'outcome' measures tend to focus upon things, products, changed behaviours, reduced pollution and so on. The number of meetings held, the number of people spoken with, the new relationships formed are deemed outputs—instrumental elements in achieving the outcome. SDG17 says they can be evidence of achieving SDG 17 in their own right.

But if relationships are central to an ecological worldview, then relationships need to be seen as an outcome, not merely a means to an outcome. The elevation of 'partnership' to a goal rather than merely a means to a goal in the SDGs reflects this approach. A project that can demonstrate it has increased the connectedness of people has achieved an outcome that increases sustainability.

Evidence (Zischka 2014, 2016; Schulter 2016; Helliwell and Putname 2005; Diener and Seligman 2004; Argyle 1996) suggests that relationality is central to adaptive capacity resilience, wellbeing, belonging and responsibility. Those who engage are happier and more resilient, whilst the more remote we feel from others, the

[4] http://relationalthinking.net/.

less we feel responsible for them. Creating a more sustainable city requires happier and more resilient people, and a greater sense of shared responsibility to enable us to take the actions required. It is both an instrument to assist in improving sustainability, but also a feature of sustainability in its own right. We are not in this chapter suggesting the measurement of relational distance as a means of quantifying outcomes, although there are well developed tools for doing so (Napier and Ferris 1993; Gittell 2012; Schluter and Lee 2009),[5] rather we argue that placing relationships at the centre of project design, management and objectives is itself an important part of developing more sustainable cities (Baker 1996; Ashcroft et al. 2015).

Young people's networks are distinctive. Whilst one can overstate the notion of the digital native, young people's networks are diverse, distributed, mobile and blend the digital and physical. Much has been said and written about young people's networks, and the centrality of digital networks both to the construction of their communities and what it means to 'belong'. Formal membership of all sorts of organisation is declining. A like on Facebook or joining a Facebook group is a means of staying in touch and showing connection, rather than becoming a formal 'member' of an organisation. The binaries of belonging/not belonging, being here or not here are no longer relevant. Connection in an array of forms is central, and importantly that is not a structured, hierarchic connection, with membership lists, organisers and categories. 'Search' as a tool has replaced the need for constant structuring of information.

We talk about young people being 'hard to reach'—yet they reach each other—what we are actually saying is: they have a different way of communicating, of seeing things, of networking. What about letting that transform us and our cities?

So if we want to work with young people, to support them in changing our cities, we too need to adopt that sort of bottom up, dispersed, networked, experimentalist approach. We need to work in their world, not force them into ours.

Central to this is a changed role for 'organisers'. Instead of creating opportunities for students, we need to create spaces in which students can invent opportunities. A classic example of this from our research was the development of Knititiative. Efforts to engage students and young people generally in issues of homelessness can come across as worthy. Too often it has the effect of preaching to the choir—engaging those already engaged. Knititiative illustrates the way in which students can create completely new connections that older people might not have thought of. Knitting is fashionable amongst students, and one student having proudly knitted her own scarf realised that homeless people need scarves. She got her friends making things, a student society was born, that led to long term engagement of students visiting a local hostel, making things that homeless people ask for and developing relationships. This engaged people who would not necessarily have been engaged by a more traditional approach. The key here is that the issue was seen from the perspective of a young person, not through the prism of agencies or older people.

[5]See also Relational Analytics and the Relational Proximity Framework.

Not only do young people have different perspectives, which link things differently, they also have different power relationships.

When institutions, as centres of power in whatever form, seek to foster partnerships there are embedded power challenges (Down and Nurse 2007). However well intentioned, institutions such as universities are experienced as centres of privilege—and it is easy for them, however unintentionally, to disempower communities. Students, whilst they carry some of this baggage, however inadvertently, also carry their youth. And that can disperse at least some of the power imbalance, with organisations and groups recognising their own sense of power in relation to young people. One experience from the case study we consider below, has been the extent to which students have not only been able to diffuse the sorts of power imbalances that would occur if academics had been involved in the same way, but have been able to have an impact upon wider views of institutions such as universities.

Seeing the concept of how young people could be change agents in city transformation is one thing, but how can the space be created for this to happen?

3 Bristol Case Study

Bristol offers a case study in how this can happen (Willmore 2016; Clayton et al. 2016a, b).

In 2015 Bristol was the UK's first (and only) European Green Capital. Public, private and voluntary sector groups, and countless individuals came together to win the title, and then to use it to make a difference to the sustainability of the city. One feature of the work that emerged was a project funded by the Higher Education Funding Council for England, entitled 'Green Capital: Student Capital'. The two public Universities in the City—Bristol University and the University of the West of England, Bristol—and their Student Unions came together to develop a process for helping students and the wider community work together—to unleash the energy of the students. They formed 10% of the city population, and the project was designed to deliver 100,000 hours of student engagement in city transformation for sustainability in 2015, and every year thereafter. Work on making the campus and curriculum of each university more sustainable was to continue, with this project focussed on engaging students as active agents in the wider transformation of the city. The partnerships here have at least three loci—student, community and academic institution.

The working hypothesis for the project was that sustainability engagement through relationships could be simultaneously transformative for students and help transform the city. Whilst education (SDG4) partnership (SDG17) and the concept of sustainable and inclusive cities (SDG11) were inherent in the rationale for the project, the aim was to engage students in activities across all seventeen SDGs, and

to help students see that whichever SDG they were contributing to, it was part of an integrated whole. The project was located within an integrative view of education in which the formal, informal and subliminal curricula combine, and within an integrative definition of sustainability that includes and integrates social, economic, cultural and environmental aspects of sustainability. Members of the project team had previously investigated the relationship between student formal, informal and engaged learning (Willmore and Tweddell 2015).

The project drew upon methodologies of co-productive action research, open innovation and experimentalist governance. Through external evaluation and internal data gathering, the project explored what could be done using a model that drew upon these concepts.

Coproduction was used both in terms of project design, with students involved on the project board, but also in terms of the ideologies informing the way students and community bodies were encouraged to develop their working. The project anticipated that by bringing different bodies together in as open and as equal a way as possible new insights and opportunities could be produced jointly. The project focussed upon empowering students and the community to work together to develop and deliver their own ideas, with the project supporting and empowering.

Given there were no similar cases which could be used as comparators from which to explore the learning from the project, the authors have sought to evaluate the transferability of the work, and the lessons that can be drawn more generally about the role of students in city transformation, through a process of asking groups of academics, professional services staff and students from across the UK to identify in workshop sessions what is transferable from this case study, and what are particularities of Bristol.

Whilst the particular catalyst event (Green Capital year) and funding source (HEFCE Strategic Catalyst Fund) is not immediately transferable, there are a great many of these special designations, any one of which could be used in a catalytic role. The key finding in this context is the need for opportunism. The approach can have any focus, there is nothing in the findings that suggest it was uniquely about 'Green Capital': any central vision could have been used. That is not to say place does not matter. Place is central to construction of experience, but that there are pathways to relationship construction which contribute to sustainability everywhere, they may be differently articulated and implemented, with different foci, but they exist.

Within the first year of the project, students put over 125,000 hours into an array of community activities spread across all seventeen SDGs, working with over 220 public sector, private sector, NGOs and communities. The activities were large and small scale, individual and collective.

The project adopted an open innovation approach (Chesbrough 2003), drawing upon notions of experimentalist governance (Rhodes 1996; Von Hohmeyer 2010; Sabel and Zeitlin 2012). Open innovation as a concept stresses the importance of looking outside of a project team, as well as within the team for ideas. External ideas are encouraged, welcomed and integrated. Whilst the project team retained responsibility for supporting ideas to come to fruition, from the outset the project

was presented to the wider community and to the student community as being about supporting their ideas and innovation, rather than asking people to participate in 'our' project. The innovations were then integrated whether they came from within the project team or beyond it. As an example, students suggested the methodology used for evaluation of the project, based upon the one they had seen used during 'Responsible Futures' accreditation, and the team adopted that instead of their original planned approach. Experimentalist governance focuses upon how innovation is supported, rather than the source of innovative ideas. It deliberately creates a provisional framework, refining it constantly in the light of feedback. The project team started with ideas about how the project could be run and what it might achieve, but sought to present the project as entirely open and malleable, so that engagement and responses from students and the community shaped and redirected the project. Some framework features remained constant—the data collection methodologies once devised had to be consistent for example—but the governance of the project and its content and focus were constantly reviewed and revised in light of evidence of what was working. The aim was to secure student engagement —how that was achieved was contextually driven by the participants rather than by the project leadership.

The essence of these approaches is that the project leadership provides permission and space for innovation. New ideas and experiments proliferate outside of the leadership coming from a range of sources both internal and external, with ideas shared rather than owned. The emphasis was upon highlighting how ideas and activities connected, not in compartmentalising or directing emphasis. As such the project methodology sought to adopt what Sterling would call a whole system approach.

Rather than establishing individual project relationships between the Universities/Student Unions and specific groups, and then recruiting to them, the project promoted the wider notion of connection. Individual and structured relationships between institutions and community groups can be resource intensive, and are prone to failure when the individuals who have constructed the relationship move on (Willmore and Tweddell 2015). But beyond this pragmatic reason, the open network approach was chosen for another important feature. Students are presented with a plethora of opportunities to engage, and often find this a competitive process, in which groups vie with each other for student attention. An aim of the approach was to be holistic, to indicate that this was about students engaging, that there were lots of ways in which to engage, and that they all contributed to the bigger whole. By defining the project in these terms, we sought to make explicit the nature of the community we were seeking to establish, and to enable students to see how their chosen activities fitted the whole. An unexpected benefit of this approach was the extent to which it empowered students to experiment, to develop new activities, to try out lots of activities, but at the same time feel they were all part of a whole, rather than just engaging in a set of disconnected activities. For example, one international student put in 170 hours of work across 10 different projects. By focusing on the holistic nature of the student-community link, we sought to recognise that student-community links are essentially dynamic, diverse and

holistic. Individual activities may develop, thrive and then reach the end of their life. That is natural and normal. When the focus is on individual projects, the ending of a project can feel like failure, rather than a natural part of the holistic relationship. By moving the focus, the aim was to enable individual activities to come and go and seek to create a dynamic model for long-term relationships.

Different aspects of the project were presented in different ways. Some activities chose to present themselves as an opportunity to acquire work related skills or experience, others chose to present themselves as fun, which happened to be socially beneficial. The project intentionally encouraged a diverse presentation of the opportunities, as students and community groups themselves have different drivers, and the aim was to empower students and community groups to 'come into the room'. The project was seen as a room with many doors. People may enter through different doors, for different reasons. They may do different things, and may move on out through different doors having had a different experience. The unifying factor was that they were in the room, and were encouraged to be aware of how their journey through that room related to the totality of the room, and to the other journeys through it. Many students reported having engaged because it looked like fun, but having left the room with new insights.

The project team have been holding workshops presenting the project to external audiences. Through these workshops the team has sought feedback about the transferability of the project. Some feedback has suggested that the prior existence of the Bristol Green Capital Partnership of over 800 organisations means the work is not replicable. It is certainly the case that the prior existence of this group made the formation of networks within which the project could operate much easier. But there are networks in all cities, finding them, tapping into them and helping them to grow is itself a vital part of playing a role in city transformation. The approaches and methodologies can be used in networks of any size, although the project evidences that there are economies of scale, and that larger-scale activities increase both the holistic nature of the experience and impact, and achieve profile and support from key power brokers in the community and institutions. However, the case study does demonstrate the feasibility and benefits of big networks, as facilitators of multiplex networking, enabling students and the community to work in a flexible and open manner, finding new synergies.

If we accept the evidence of relationships as central to transformations for sustainability, then building those diverse dispersed networks is itself a step towards sustainability. The notion of connectivity between different activities was recognised by the establishment of a 'Change Maker Award', designed to recognise students who have put in significant amounts of time, and who have shared with others the benefits of engagement. The award recognises contribution towards a more sustainable city, whatever the form that takes.

In evaluating the case study, in terms of the scope for young people—in this case students—to have a role in city transformation for sustainability, two levels of data need to be considered: the traditional 'output' measures, and the relational impact measures.

In terms of hard numbers and practical outcomes, 2784 students took part, not the whole student body, but approximately 10% of the student body, and that itself is a significant percentage of the city community. Students contributed over 125,000 hours of work with a range of community organisations and firms—equivalent to over 74 years' worth of work. Using ONS data this represents a financial contribution of £1,194,085[6] to the city's green economy. Beyond this, several of the projects provided significant added value, which it is difficult to quantify; for example, one project set up within the overall project linked NGOs who wanted to revise their business or develop one, being linked with taught postgraduate students who had been studying NGO business planning. Together the students and community groups worked on developing a new business plan, as partners: each bringing different skills. The results led to significant gains for the groups; for example, one reported that it had secured a new long-term lease and funding as a result of its new business plan and others directly used student contributions in new digital publications. In another example, a cycle business made a decision to relocate to Bristol, and now sells three times as many bikes, based upon work done by students. In-and-of themselves, these sorts of outcomes further evidence the benefit of engaging students in their cities.

The project was predicated upon an holistic view of sustainability, and student activities spread across the whole range of SDGs. Education (SDG4), sustainable cities (SDG11) and partnership (SDG17) were are the core of the project, but the activities within the project spread across the full range of SDGs

However, what is perhaps more important than these particularities of outcome is the broader impact of the work upon relationships, both with the groups involved and the students involved.

Following the first year of this on-going project, the work was evaluated through surveys of participants, and through an external independent evaluation.

Surveys of participants produced high levels of satisfaction, over 97% of students surveyed reported that found the activity worthwhile, enjoyed the experience, felt useful, and felt that their work had had a positive impact. Qualitative data from respondents, and in particular a comparison of what they said they hoped to get from the engagement, and what they got, highlighted the issue of relationships. Students said they had got involved to get experience: because it offered choice, and low risk; but afterwards, the dominant themes in students' explanations of what they felt they had gotten from their involvement was about relationships: feeling they belonged, getting experience of different people and places, skills of working with different people, and above all the realisation that people and relationships are key to getting things done.

[6]The economic contribution was calculated based on assumptions of an average 37 h working week and 46 week working year, using the Office for National Statistics (ONS) Annual Survey of Hours and Earnings (ASHE) 2014 figure for median UK hourly income (excluding overtime) of £11.61 for volunteering and project work hours, and the institutions' standard wage for placements and internships of £6.75 per hour.

These were not confined to interpersonal relationships. Students said it had made them feel they belonged, to Bristol and to their university, and feedback from community groups suggested the work had an impact on community—university relationships, as well as individual ones. One respondent group from an area that traditionally is less connected to the universities said:

> It has been fantastic to work with the University as well: lots of people in this area don't go on to University or have any connections. It has really changed our perceptions.

The sense of belonging, with its impact upon resilience, was particularly marked in the responses of international students, and was important for enabling them to develop and progress well in a new country. Significantly, 39% of the participating students were from non-UK residency, compared to 14% of the base population of students, suggesting a markedly higher participation by international students.

Given the limitations of self-reporting as an evaluative tool, an external evaluation was carried out by the National Union of Students (NUS). The methodology of this evaluation was adapted from their Responsible Futures programme in which students are trained to act as auditors alongside experts. The audit of documents and interviews over a two-day period provides an external evaluation. The evaluation report (NUS 2016) identified both practical and relational benefits.

What surprised them most was "the overwhelmingly positive feedback from both students and external community partners. It was really pleasing to see how useful the students felt, and how much community partners valued their impact and would recommend working with Bristol students to other organisations".

The evaluation team commented that "The level and quality of student engagement over the past year is absolutely incredible and offers an incredible platform upon which to continue to strive towards creating graduates who are ready to tackle the world's greatest sustainability challenges—during their degree and when they graduate."

These relationships are characterised as being multiparty, with students, community groups, individuals and institutions seeking to work as equals within space for shared conceptualisation, articulating the benefits to all involved and understanding each partner's constraints. Such relationships need support through brokerage, and through the construction of the space within which they can operate. Key to this work is decentring the university as a centre of privilege, so it can become a resource and also itself see the city as a resource.

The individual case study has won national and international sustainability awards,[7] but what is transferable from it? Workshops with academics, professional staff and students from other universities suggest that whilst there might be particularities about the Bristol context, there are lessons of wider application. The biggest feature that emerges as transferable is the notion of building partnerships: within institutions, between institutions and across communities. The particular benefits of placing students at the centre of this process, as agents of change who

[7]Green Gown 2016; International Green Gown 2016.

can break through some traditional boundaries, was seen as innovative, but transferable. The open nature of the project, empowering co production and innovation, and trusting students with big responsibilities was seen as important.

4 Conclusion

Drawing upon the Bristol case study, there is evidence that young people, in that case students, can make a significant contrition.

If we are going to create more sustainable cities, we cannot discount the young people in those cities. They are part of the community, and are a particularly valuable subset. The Bristol case study shows how students as young people can be mobilised and motivated to act as change agents in their community, and themselves be changed by the process. Whether those lessons become life-long changes of practice can only be determined long-term, but the lessons about the importance of relationships have been learnt.

The SDG commitment to partnerships as central to sustainability dovetails with Sterling's argument about the centrality of relationships. Students as change agents have shown they can break through some traditional relationship boundaries to forge new connections, and in the process can learn a deeper awareness of the importance of relationships in achieving change. The case study suggests young people can be repositioned from primarily objects of need or concern to co-creators of change for sustainability in cities and can contribute actively to the attainment of all of the SDGs and through doing so can themselves benefit from a more sustainable education. It demonstrates that they have something distinctive to contribute specifically *because* they are young people, rather than *despite* being young: because they see the world differently and therefore have the potential for creating real innovation in the way we address the sustainability challenges we face in our cities across the globe.

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Climate Change Education for Sustainable Development in Urban Educational Landscapes and Learning Cities. Experiences Perspectives from Osnabrück

Gerhard Becker

Abstract There is now a widespread consensus that global climate change can only be contained and managed through a quick, fundamental and worldwide societal transformation involving politics and all societal forces. The great importance of the local level of action and climate change education (CCE) as well as other education on climate change mitigation and adaptation is becoming increasingly recognized. However, the practical implementation still requires much development—at least in Germany. Even having many good community-based, individual measures and projects regarding climate education is apparently not sufficient. It is also necessary to systematically develop and network the diverse activities of CCE in all educational areas to provide citizens with an opportunity for lifelong learning as well as link the climate-related activities and political measures. For the strategy of establishing connections between key actors that is the central focus of this article, the term *Bildungslandschaften* (educational landscapes) will be further developed. This term is becoming increasingly prevalent in Germany and is related to the international concept of *learning cities* (Sect. 4). As a basis for this perspective, Sect. 1 provides a geopolitical overview of the role of the local level and education, from the UN Conference on Environment and Development in Rio de Janeiro (1992) to the Sustainable Development Goals (SDGs) and the Paris Agreement on climate change (2015). Finally, the respective situation in Germany will be critically examined. In Sect. 2, the author presents his six-dimensional model of sustainable development as a theoretical foundation, with education as an independent dimension. In Sect. 3, he applies the model to the thematic area of climate change education for sustainable development (CCESD). Section 5 deals with the example of the city Osnabrück: The author reconstructs the complex 30-year previous history of climate education and an educational landscape for sustainable development in Osnabrück and discusses successes and problems.

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Climate change education

1 The General Role of Education in Managing Climate Change

The need for fundamental societal learning processes to address central problems of humanity was already a topic of discussion as early the seventies. For instance, the topic was mentioned in the UNESCO Publication *Learning to be* (Faure et al. 1972) and in the Club of Rome book *No Limits to Learning* (Botkin et al. 1979), which mainly discussed the challenges related to the energy supply after the oil crisis in 1973.

1.1 International Context

In an international context, education, social participation and action at the community level are clearly seen as playing key roles in sustainable development, as reflected in many international resolutions and documents. At the UN Conference on Environment and Development in Rio de Janeiro in 1992, for example, several resolutions were passed that had a major global historical impact, especially on sustainable development. These resolutions include Agenda 21 (UN 1992a) and the UN Framework Convention on Climate Change (UNFCCC). The objective of this Convention was to 'stabilize greenhouse gas concentrations in the atmosphere at a level that would prevent dangerous anthropogenic interference with the climate system' (UN 1992b). At that time, education, training and public awareness were already considered as factors contributing to climate protection (see Article 6 of the UNFCCC). This important aspect of education in the broadest sense was also formulated as Principle 10 in the *Rio Declaration on Environment and Development* in 1992, together with social participation. Furthermore, education was described in detail as a general instrument for sustainable development in Chap. 36 of Agenda 21, while the protection of the atmosphere was a central topic in Chapter "Making Rural and Urban Connections by Integrating Nutrition and Agriculture: A Case Study of Food and Nutrition Security Instruments". At the same time, the importance of action at the community level was recognized in both UN documents, and Agenda 21 even dedicated a separate chapter, Chapter "Promoting Sustainability: The Role of Smart Cities", to this subject (see Sect. 1.2).

While the importance of these factors is internationally recognized, there is great variation up to now in how consistently the individual states have implemented the

far-reaching UN resolutions from Rio de Janeiro in 1992 and from the many follow-up conferences. The same is also true for resolutions from the annual Conferences of the Parties (COP) in the area of climate change.

In the following, I will present and critically evaluate a few recent developments at the UN level with respect to the broad and globally important field of action *education and climate change.*

The UN proclaimed 2005–2014 as the Decade of Education for Sustainable Development (DESD). From the beginning, climate change was a very important international issue of the DESD (e.g. UNESCO 2005a/b, 2009a/b).

Furthermore, climate change and education played a key role during the second follow-up UN Conference, Rio+20, which was once again organized in Rio de Janeiro in 2012, as reflected in the resolution 'The future we want' (UN 2012). Nevertheless, at least until 2011, there was still an educational deficit in climate strategy and politics that was apparent worldwide. UNESCO sought to address this deficit. On its website, UNESCO wrote the following: 'Through its Climate Change Education for Sustainable Development programme, UNESCO aims to make climate change education a more central and visible part of the international response to climate change. The programme aims to help people understand the impact of global warming today and increase "climate literacy" among young people'.[1] The issue of climate change education (CCE) was expected to be given much higher priority after 2015, a year in which the UN and UNESCO set foundations for future action at two global conferences, Agenda 2030 and the UN Climate Conference in Paris. In September 2015, Agenda 2030 (UN 2015a) was issued with 17 Sustainable Development Goals (SDGs)[2]. The following three SDGs are the most relevant for CCE:

- 'Ensure access to affordable, reliable, sustainable and modern energy for all' (SDG 7),
- 'Take urgent action to combat climate change and its impacts' (SDG 13),
- 'Ensure inclusive and equitable quality education and promote lifelong learning opportunities for all' (SDG 4).

The UN Climate Conference that was held in Paris at the end of 2015 differed from the previously organized International Climate Conferences in so far as it is generally regarded as a breakthrough in global politics. The highly ambitious aim of keeping global warming below 2 °C or better, below 1.5 °C, nevertheless requires very consistent global climate policies right from the start that aim at reducing the greenhouse gas emissions to zero as quickly as possible.

Adaptation and *mitigation* are two fundamental terms in the debate on climate change. The International Panel on Climate Change (IPCC) defines mitigation as

[1] http://www.unesco.org/new/en/education/themes/leading-the-international-agenda/climate-change-education, 1.7.2011.

[2] All SDGs contain 'Sub-SDGs', i.e. precisely formulated subgoals—a total of 167.

'an anthropogenic intervention to reduce the sources or enhance the sinks of greenhouse gases'. Adaptation may be defined as 'an understanding of how individuals, groups and natural systems can prepare for and respond to changes in climate or in their environment'.

It would be impossible to achieve this target of adaptation and mitigation, which is so vital for humanity, without relying on systematic educational measures in terms of lifelong learning whose aim is to significantly shape the attitudes and behaviour of as many people as possible. In the general phrasing of the Paris Agreement on climate change (UN 2015b), which has been repeatedly mentioned in the international UN resolutions since 1992, the important role of education is emphasized: 'Affirming the importance of education, training, public awareness, public participation, public access to information and cooperation at all levels on the matters addressed in this Agreement'. Due to the great significance of the topic climate change, it makes sense to use a special term for the related education: c*limate change education for sustainable development* (CCESD or, concisely, CCE). The corresponding German term *Klimabildung für nachhaltige Entwicklung* (short form: *Klimabildung*) has been seldom used up to now in Germany (see Sect. 1.3).

1.2 Importance of the Local Action Level

The previously mentioned Chap. 28 from Agenda 21 ('Local authorities' initiatives in support of Agenda 21') (UN 1992a) was the starting point of numerous sustainability initiatives and processes in thousands of communities in numerous countries in the world, all under the name of 'Local Agenda 21'. This global movement is mainly characterized by the participation of citizens and non-governmental organizations that foster fundamental learning processes among active members as well as the local public. Incidentally, the idea that towns and cities as well as education are of high importance when it comes to shaping the development of our future was already expressed 20 years before in the UNESCO publication *Learning to be* (Faure et al. 1972). The subsequent UNESCO report *Learning: The Treasure Within* (Delors 1996) already deals with the idea of learning societies (see Sect. 4 in the current article).[3] The increasing importance of the local action level can be seen in the founding of two international organizations representing the towns, cities, communities and rural districts. Unfortunately, both organizations fail to mention CCESD explicitly within the scope of climate change and sustainability.

In 1990, the *International Council for Local Environmental Initiatives* (ICLEI) was founded at the conclusion of the first World Congress of Communities for

[3]More detailed in Becker (2016), pp. 126–128.

Sustainable Development at the United Nations in New York. This council includes a worldwide association of towns and cities, communities and rural districts, which has gone by the name *ICLEI – Local Governments for Sustainability* (http://www.iclei.org/) since 2003 (ICLEI 1994). Although one focus of their work is climate change, CCESD is not mentioned in any of their publications (see ICLEI 2015, 2016a). Within the context of ICLEI, the Aalborg Charter of European Cities & Towns Towards Sustainability was adopted in 1994 and signed by approx. 2500 local and regional administrations in 39 countries (http://www.sustainablecities.eu). In the Basque Declaration (ICLEI 2016b), the updating of the network's objectives refers explicitly to the SDGs and the Paris Climate Agreement. However, it is a surprising point of criticism that the issue of CCESD is not mentioned explicitly in any of the ten Local Agendas or the 15 pathways to sociocultural, socioeconomic or technological transformation in the Basque Declaration.

Another example of such an organization is the group European Network of Cities, Towns and Districts in Partnership with Indigenous Rainforest Peoples for the Benefit of the Global Climate (Climate Alliance), which was founded in 1990 and has grown to about 1700 member communities from 26 European countries (http://www.climatealliance.org). Climate justice for the indigenous people in South America is a central aim. Neither of the two organizations explicitly declared local CCESD as one of their major targets, and although the latest publication of the Climate Alliance *Transforming Our World. Local Authorities for Global Sustainable Development* (Climate Alliance 2016) includes the network's offerings on CCESD, these only refer to informal forms (international campaigns, expositions). There are also other international networks of municipalities that express the importance of the local level for different fields of action, for example, the network Transition Towns and Fair Trade Towns.[4] But here too, education or CCESD in particular does not seem to play a major part. This clear deficit with respect to education in all these networks underlines the necessity of developing local holistic concepts of CCESD which will be primarily substantiated and presented by means of examples in this paper.

Ever since the UN's Agenda 21 was written in 1992, the local level has been recognized as an important factor. In 2015, the UN formulated sustainable development goals (SDGs) in its Agenda 2030. One example is SDG 11: 'Make cities and human settlements inclusive, safe, resilient and sustainable'. This SDG along with SDGs 4, 7 and 13 on climate change form an argumentative basis in support of local CCESD. In Sect. 3.2, the SDGs are related to the ESD learning objectives (UNESCO 2017).

[4]https://transitionnetwork.org/ http://www.transition-initiativen.de/ http://www.fairtradetowns.org/ https://www.fairtrade-towns.de.

1.3 On Climate Policy, Climate Science and Climate Education in Germany

All the conferences, resolutions and programmes on sustainable development (SD) and climate change mentioned so far were met with a strong positive response in Germany. At this point, I shall merely refer to some aspects of the political activities with respect to climate change. These include research and promotional programmes developed at the federal and regional levels that also refer in part to the local and/or community level, which is in the focus of this paper.

In 1997 on behalf of the Federal Ministry for the Environment, Nature Conservation, Building and Nuclear Safety (BMUB), the *Deutsches Institut für Urbanistik* ('German Institute of Urban Studies'; DIFU) published the practical guide 'Climate Protection in Communities' (*Klimaschutz in Kommunen*; DIFU 1997), which was published in 2011 in an updated version of more than 500 pages (DIFU 2011). In a short chapter 'Public relations and consultation', the guide merely dedicates three pages (pp. 160–163) to education in the sense of 'lecture and discussion events'.

Later, within the framework of the German National Climate Initiative, the Federal Ministry for the Environment (BMUB) developed promotional programmes for climate protection in communities, for instance, the 'Masterplan 100% Climate Protection' from 2012 as well as awards for 'Climate Communities' (see http://www.klimaschutz.de). The targets are reflected in the following four theses concerning the promotional programme:

- Climate protection needs leverage—a small impetus may have a strong impact
- Climate protection needs the economy—networking is necessary for climate protection
- Climate protection needs communities—towns, cities and communities promote climate protection
- Climate protection needs management—to identify potentials and use these to the fullest.

To support community approaches and projects in a practical way, the *Service- und Komptenzzentrum Kommunaler Klimaschutz* ('Service and Competence Center for Local Climate Protection') has used the previously mentioned guide 'Climate Protection in Communities' as a basis for publishing numerous brochures on individual topics, in which practical examples are presented as models. However, climate education is hardly mentioned (e.g. DIFU 2015a/b). What all these measures at the German federal level have in common is that they tend to disregard the role of CCESD or, to be more precise, hardly make any connection between climate protection measures and education or recommend such a connection. Neither do they refer to the educational material that was developed by the same ministry for

the different school levels (e.g. BMUB 2009).[5] Of course, this is an expression of the lack of communal responsibility, mostly due to very limited financial resources and the missing competences at the municipal level in terms of education on sustainable development and climate change subjects.

The policy document of the Association of German Cities (*Deutscher Städtetag*) 'Adaptation to the Climate Change—Recommendations and Measures of the Cities' (DST 2012b) also does not make any statement at all regarding any kind of CCESD, even though the Association of German Cities already emphasized the significance of education for the future development of the cities twice in the *Aachener Erklärung* ('Aachen Declaration'; DST 2007) and in the *Münchener Erklärung* ('Munich Declaration'; DST 2012a). The Munich Declaration even emphasizes the 'increased significance of ESD' in the introduction.

Whilst scientific climate studies generally deal with the respective natural science fundamentals and may also include socioeconomic, cultural and historic aspects if need be, they tend to ignore the educational aspect. There are two major exceptions of renowned research institutes that deal with this issue in a completely different manner:

In a more recent publication of the German Advisory Council on Global Change (WBGU 2011), the importance of scientific research and education in the social transformation process towards SD is raised as a subject of discussion. Closely related to this subject, the call for active participation by citizens (e.g. WBGU 2014) and the transformative significance of cities (WBGU 2016) are addressed in expert reports.

In recent years, the Potsdam Institute for Climate Impact Research (PIK)[6] has dealt with education in a special project and offered knowledge on the climate to interested educational actors in a creative manner (http://www.klimafolgenonline-bildung.de). The project focuses on the presentation of scientific expertise on the impact of climate change and its consequences. The portal makes it possible to study and visually display the impact of climate change on Germany on the computer with future and past scenarios based on data measured since 1900. In addition, teaching material is presented on the service portal http://www.lehrer-online.de, which is aimed at teachers from all school types and levels.

Naturally, in Germany, there has also been a diverse educational practice regarding the topic of climate change[7] and the related publications: Numerous didactical materials referring to the topic of climate protection can be found, for instance, on the national websites http://www.bne-portal.de and http://www.globaleslernen.de or as collected in the comprehensive literature database

[5]Written enquiries from the author with regard to CCE to the BMUB, DIFU and with the European Climate Association did not lead to any appreciably different results.

[6]https://www.pik-potsdam.de information on the educational project PIKee can be found at https://www.pik-potsdam.de/forschung/klimawirkung-vulnerabilitat/projekte/projektseiten/pikee.

[7]Initially, school-related networks worked in this respect, e.g. the Climate Alliance of Schools in Lower Saxony, which is no longer active.

BNELIT for ESD at http://www.bne-literatur.de. An interesting international website is that of the non-profit foundation 'myclimate' (http://www.myclimate.org), with Swiss roots, which is counted among the leading providers of voluntary compensation measures worldwide. This foundation also stresses the great importance of CCESD and thus combines different dimensions of SD in its efforts. Nevertheless, it appears that the debate, the development and implementation of concepts in Germany have lagged behind the international level of discussion on CCESD. One indication of this—as already explained above—is that the German term *Klimabildung* has not yet become an established term within the German-speaking areas. In contrast, the term *climate change education* (CCE) is already a subject of an UNESCO Initiative (UNESCO 2010) and is a widespread term in academic publications (e.g. Leal Filho et al. 2007; Mochizuki and Bryan 2015). As early as 1999, the American portal http://climatechangeeducation.org was launched, which addresses all different kinds of groups of actors and is administered by a broad spectrum of educational actors.[8] Unfortunately, the field of education science has so far largely ignored the topic of climate change.

2 Education as One of Six Dimensions of Sustainable Development

The UN global conferences on SD and climate protection mentioned in Sect. 1 are global political compromises, especially between developing and industrialized countries. As a result, the terms employed are often unclear. Within the different contexts, especially within the context of academic discourse, the terms are often used with very different meanings that can even contradict each other. Humanity will have to learn how to democratically deal with this conceptual diversity and different views. Diversity does not imply arbitrariness and does not release us from the responsibility to develop ideas, theories, strategies and practical approaches, to try these out and to revise them again, quite the contrary. Also the results and claims that were formulated in the new Paris Agreement about climate protection at the end of 2015 are based on the central term *sustainable development (SD)*. Despite all the diversity and difference of the proposed ideas and their sociocultural backgrounds, there are certain similarities at a highly abstract level. Firstly, there is a highest ethical goal that is repeatedly cited in the *Brundtland Report* (UN 1987)[27]: 'Humanity has the ability to make development sustainable to ensure that it meets the needs of the present without compromising the ability of future generations to meet their own needs.'

[8]The comprehensive literature regarding CCE in the English-speaking countries cannot be discussed in detail here.

To achieve this goal, an integrated view should be taken as a basis for analysis and planning. Generally, this will include ecological, economic and social aspects as dimensions that are essential to be considered. This pattern is often called the *Triangle of Sustainable Development* and is presented graphically in many different forms. The German and global debate, however, also comprises other, more differentiated models of SD which involve more than three dimensions. SD's high demand for political participation as well as education suggests that these two areas be understood as further dimensions of SD, not necessarily derived from the first three dimensions. Already in the Framework Convention on Climate Change of 1992 in Rio de Janeiro (UN 1992b) and in the Paris Agreement (UN 2015b) as well as in the entire global climate debate over the past 25 years, these two additional dimensions have arguably played as great a role as the other three dimensions.

Although right from the start, there were many reasons to support the idea of understanding *culture* as a further independent dimension, this was largely ignored[9]. At the same time, the cultural dimension is of great importance at the level of everyday culture in terms of different lifestyles, patterns of thought, attitudes and values (particularly in urban areas) for both the strategy of SD as well as for climate change mitigation and adaptation. Generally, the aim is to fundamentally change the socioculturally influenced lifestyles and thought patterns. Nevertheless, sometimes it is also sensible to preserve proven traditional practices, which were suppressed during globalization, or to carry these practices on in a modified manner. In the meantime, further reasons for considering the cultural dimension of SD have been expressed in UN resolutions:

- The Convention on Cultural Diversity (UNESCO 2005a) states in Art. 13 (Integration of Culture in Sustainable Development): 'Parties shall endeavour to integrate culture in their development policies at all levels for the creation of conditions conducive to sustainable development and, within this framework, foster aspects relating to the protection and promotion of the diversity of cultural expressions.'
- Also in Agenda 2030 or the SDGs (UN 2015a), (inter)cultural aspects are of great importance. To achieve the goals of the climate conventions, a cultural change is indispensable in most cultures.[10] In addition, due to globalization and the growing number of refugees, many countries and communities are becoming increasingly 'multicultural' societies. Finally, this six-dimensional conception allows a broader spectrum of potential actors, especially within the local educational landscapes (see Sect. 4).

[9]Here is one example: The climate-culture project of the Institute for Advanced Studies in the Humanities in Essen (http://www.kwi-nrw.de/home/projektbereich-3.html) systematically analysed the cultural dimension of climate changes (Leggewie and Welzer 2009; Welzer et al. 2010).

[10]Of course, the reverse also holds true, i.e. that climate has shaped our culture—the cultural history of the climate (see Behringer 2007).

The model that I developed nearly twenty years ago contains all these additional SD dimensions, namely, ecology, economy, social justice, participation, culture and education. Thus, in terms of content, the model is in line with the idea of UNESCO as an international organization for 'education, science, culture and communication' on basis of democracy, development and human dignity.

Therefore, this six-dimensional model[11] for SD will be taken as a basis for dealing with climate change in the following, or at least it is recommendable to do so. It is important to utilize the model with all levels of action—from local to global—which are closely interconnected in the age of globalization. This differentiated model offers some important advantages: First of all, it allows non-sustainable development situations to be more precisely analysed and helps to detect strong and weak points more quickly in a systematic manner. Often, the failure to consider some of the dimensions has its roots, for example, in the one-sided economic action of business enterprises and also in national economic policies to achieve short-term economic targets. Furthermore, the six model dimensions provide criteria for evaluating SD strategies and measures as well as for making simple comparisons of approaches. According to this, purely ecological strategies of conservationists would be one-sided and not very promising, especially if they ignore the cultural dimension or political participation dimension. On the other hand, special importance or even priority should be given to the ecological dimension, as protecting the natural living conditions is the basic precondition for any SD ('strong sustainability'). The same is true for climate protection.

In addition, each individual dimension should be considered in a differentiated manner: This is clearly evident, for instance, for the social dimension, when understood as a demand of social justice for sustainable development and climate justice in particular. In the case of intergenerational justice as a perspective of time, the question arises as to how many future generations should or could be considered. In addition, there is also a geographical side of justice, which may be divided into at least four further levels, a subject that may be of a highly politically explosive nature:

- The social level of the individual city/region (e.g. Osnabrück)
- The national level (e.g. Germany)
- The level of industrial greater regions (e.g. EU)

[11]Since 1999, this star graphic has been utilized and published by the author in different variations related to different topics (e.g. see Becker 2001, 2013, 2016, 2017). In the ideal case, all six dimensions are weighted to the same degree, which is expressed by the equal size of the points of the star. In practice, however, the six dimensions are mostly weighted differently in terms of the different interrelationships.

- The less developed countries, in the past designated 'Third World'[12]. In the meantime, the situation has become a bit more differentiated (emerging countries, Fourth World, Fifth World).

The six-dimensional model with the necessary additional differentiations from the individual dimensions offers criteria and questions for planning the strategies and measures for individual topics and fields of action, in particular in urban educational landscapes (see Sect. 4) such as, 'What is the cultural aspect of mobility, for instance, in our city or region?' But also this differentiating model cannot furnish clear and consistent solutions or generally accepted results but should be regarded as an instrument for assessing social situations in a critical manner and for evaluating suggested strategies for obtaining SD (see Kehren 2016) —last but not least, in the context of ESD and CCESD in particular.

3 Climate Change Education for Sustainable Development (CCESD)

The highly complex subject of climate change, including climate change mitigation and climate change adaptation, is vitally important for the future humanity's basis of life. The subject is characterized by its interdisciplinary nature, referring more or less to all other subjects or fields of action of (non)sustainable development. The subject of climate change may encompass topics such as living/buildings, consumption/raw materials, mobility/traffic systems, nutrition/health, water courses/water, biological diversity/nature of city, and so on. This is a further reason to use a specific term for the climate-based education work based on it: Climate change education (CCE), as I understand it, should always also be ESD and therefore CCESD. Due to its global significance, CCESD should always also be understood as global learning. The different conceptual ideas of SD are also reflected in the different definitions of CCESD. This is also true regarding the dimensions and competences to be acquired.

3.1 Five Dimensions of Climate Change Education (CCESD)

The six-dimensional model of SD presented in Fig. 1 implies that ESD, or CCESD, relates to the five other dimensions. Along the lines of the argumentation in Sect. 2, the five dimensions related to education provide sound, differentiated bases for the

[12]This level is of great importance and has also in Osnabrück been considered as a North-South problem of climate change for many years (see Sect. 5 on Osnabrück).

Fig. 1 G. Becker: Six-dimensional model of SD and climate protection (six-pointed star)

didactical analysis and planning of ESD. This is especially true for CCESD and for the development of local educational landscapes or learning cities (see Sect. 4)

The six-dimensional model may be substantiated by answering the following three sets of questions:

- What are the ecological, social, economic, political participatory as well cultural dimensions or aspects of climate change and climate protection? (Collection of ideas and suggestions)
- What are the correlations and contradictions between these aspects/dimensions?
- How can these aspects/dimensions/correlations and/or contradictions be made a subject of discussion in educational projects in a manner appropriate for the target group? (Didactic selection).

It goes without saying that it is impossible to consider all dimensions in each individual project. How and when can aspects and dimensions that were initially excluded nevertheless be pedagogically considered? For instance, it is quite common to spread the different aspects/dimensions of a subject out over longer periods of time, particularly in the multiyear curricula of formal institutions of general education, such as schools, educational study courses and study components. Complex tasks can also be educationally offered in a complementary and cooperative manner in locally developed educational landscapes or learning cities. Such local frameworks may provide very good opportunities and should be considered when educational landscapes or learning cities are planned in a community-based form of organization. However, in any case, this requires careful long-term planning and good coordination of the actors.

The cultural dimension has significance not only for the contents of ESD and CCESD, but also for the methods: there are also many other creative, cultural, artistic approaches and presentations that offer starting points for social

transformation for various lifestyles. In this way, the educational measure will be very successful and the participants will enjoy it. Within the course of communal public relation activities or campaigns for climate protection, even the most different forms of cultural events may assume important functions for different target groups.

3.2 Competences and Learning Objectives

In the international educational discourse, competences as the primary goals of education are playing an increasingly important role.[13] At least in Germany, the discourse on theoretical fundamentals of ESD and global learning is largely marked by competence acquisition as an objective of ESD (Bormann and de Haan 2008). To this end, a number of theoretical models have been developed. In Germany, the 'shaping competence' model (*Gestaltungskompetenz*) as the highest objective of ESD is the most widespread (de Haan 2010). This shaping competence model strongly expresses an action orientation and comprises up to 12 subcompetences that are assigned to distinct categories. So far, no attempt has been made to systematically apply this to the subject of climate change (or other SD subjects). This may be also be because the notion of shaping competence is understood in a very formal manner, an aspect also met with criticism (cf. Kehren 2016 or Overwien and Rode 2013). In relation to climate protection, shaping competence could be summarized in the following definition.

A shaping competence for CCESD is the ability to apply acquired knowledge to the climate crisis and its future solution to one's own action. The knowledge may be applied at various levels in private and professional life as well as in civic action towards social and political change. In doing so, ecological, social, political and cultural and possibly other aspects and their interrelationships must be considered. In all cases, the shaping competences should imply climate-conscious attitudes and motivation (see Sect. 4.4).

One of the first major publications relating ESD to the SDGs from 2015 was published in March 2017 by UNESCO under the title 'Education for Sustainable Development Goals Learning Objectives' (UNESCO 2017). This includes the description of 5 cognitive, 5 socioemotional and 5 behavioural learning objectives for all SDGs. For each of the 15 learning objectives, an SDG was added. Furthermore, more than 10 'topics for SDGs' as well as many examples of learning approaches and methods for SDG learning objectives were also added. For example, in the area of SDG 13 (climate action) and therefore for CCESD, one finds among others the following learning objectives: 'The learner … knows which

[13]For this, compare the educational standards in Germany and the competence approach of the OECD, which is taken as the basis in all international comparative educational studies, e.g. http://www.oecd.org/document/49/0,3746,en_2649_33723_14112625_1_1_1_1,00.html.

human activities—on a global, national, local and individual level—contribute most to climate change (cognitive) … is able to understand their personal impact on the world's climate, from a local to a global perspective (socio-emotional) …. is able to anticipate, estimate and assess the impact of personal, local and national decisions or activities on other people and world regions (behavioural)'. A topic for this SDG is, for instance, 'Future scenarios (including alternative explanations for the global temperature rise)'. One example for learning approaches and methods is 'Develop and run an action project or campaign related to climate protection'.

Certainly, a different division or formulation of these learning objectives would also be possible. In my opinion, it would be better to separate the social from the emotional learning objectives. Also, one should speak of action learning objectives instead of behavioural learning objectives. Both terms are used in most competence models of ESD. Nevertheless, it should be kept in mind that many scientists from different countries participated in formulating these objectives. Therefore, the UNESCO publication represents a compromise, as is mostly the case with international organizations like UNESCO. Still, this proposal is a major step towards substantiating the learning objectives and the desired competences with respect to the SDGs. Such compromises should be the goal in the practical and democratic design of educational landscapes.

4 Educational Landscapes for Sustainable Climate Development

This contribution focuses on the special importance of the local level of action for sustainably dealing with climate change and the role of education in this global challenge pertaining to the future of mankind. In the long run, local educational measures can only be successful if offered in all areas of education: This includes institutions related to family, preschool, school education, vocational education, university education as well as to enterprises and their employees. In the increasingly important field of informal education, many creative persons are active. Consequently, education, in the broad sense represented here also comprises information, counselling and professional qualification. It therefore has to do with a local overall concept for 'lifelong learning'[14] (see Sect. 4.1).

Also, the area of educational institutions, such as in schools, it is not enough to raise the climate change as a learning subject in lessons or in interdisciplinary teaching. What is required is a 'whole institutional approach'. In the '*Roadmap*' of the Global Action Programme ESD (GAP ESD), this is the second of the five priority action areas: 'Transforming learning and training environments: Integrate sustainability principles into education and training settings' (UNESCO 2014). In a comparable way, such a holistic approach is important for the local community

[14]The related literature is comprehensive and outside the scope of this article.

level. This also corresponds to the purpose of the fifth priority action area of this roadmap: 'Accelerating sustainable solutions at local level: At community level, scale up ESD programmes and multi-stakeholder ESD networks'. The term used in the German version, *Bildungslandschaft* (educational landscape), corresponds as far as the contents and the target is concerned approximately to the term *multi-stakeholder networks* in the English version. It is the networking and coordination of a local educational landscape that defines its special quality.[15] Unfortunately, most communities in Germany as well as presumably also in other countries of the world are nowhere near such local goals. There are, however, some positive exceptions on the level of some very small communities where the mayor and some committed citizens and associations have succeeded in this respect.

4.1 Local Educational Landscapes—Learning Cities

The background of the term local or communal educational landscapes in Germany originally had only little to do with ESD or CCESD. It deals rather with social problems and the role of schools and the following aims:

- Education as a central theme of community development
- Networks on the topic of education for the learning subject
- Connecting formal and non-formal education (especially for youth)
- Opening educational institutions in the city districts
- Utilizing preferably diverse educational opportunities
- Communal collective responsibility for education
- Cultural education in local educational landscapes.

In 2007 and 2012, the German Association of Cities (*Deutscher Städtetag*) issued declarations on communal educational landscapes (DST 2007, 2012a). The Association started off from a holistic concept of education and stressed, 'With their manifold institutions, cities and towns shape the local educational landscape of Germany: nurseries, family centres, institutions for child and youth work, schools, adult education centres and numerous cultural institutions are corner pillars of the public infrastructure of education' (translated from the German original by the author). In 2011, the foundation of the political party *Die Grünen/Bündnis 90* dedicated its work to the subject of local educational landscapes; but surprisingly, not a word was mentioned about SD nor climate change (Heinrich-Böll-Stiftung 2011).

Also at international level, similar initiatives were developed under the term *learning cities,* organized by the Institute for Lifelong Learning of UNESCO—initially without any reference to ESD or CCESD.

[15]The author (Becker 2016) deals with this question in a more detailed manner under the aspect of ESD.

A learning city promotes lifelong learning for all. UNESCO defines a learning city as a city that:

- effectively mobilizes its resources in every sector to promote inclusive learning from basic to higher education;
- revitalizes learning in families and communities;
- facilitates learning for and in the workplace;
- extends the use of modern learning technologies;
- enhances quality and excellence in learning; and
- fosters a culture of learning throughout life.

In doing so, the city enhances individual empowerment and social inclusion, economic development and cultural prosperity, and SD.[16]

The UNESCO Global Network of Learning Cities is an international policy-oriented network providing inspiration, know-how and best practice. In October 2013, the first International Conference of Learning Cities was organized in Beijing for the creation of a network of cities. In September 2015. The second International Conference on Learning Cities was held in Mexico (UNESCO 2015) with a Statement on Sustainable Learning Cities. This orientation towards SD was expressed in an international workshop in December 2016 in Hamburg regarding the topic 'Global Action Programme on Education for Sustainable Development and Cities', in which many examples were presented and discussed.[17]

4.2 Local Educational Landscapes for Sustainable Development (ELSD) for CCESD

The idea of local ELSDs was born in Germany, more or less at the time of the *Aachen Declaration* (DST 2007). At the same time during the UN Decade of ESD, communities began to receive awards for their exemplary activities in the field of ESD. By the end of the UN Decade of ESD, 21 small and large communities had been awarded once or several times by the German Commission for UNESCO (DUK 2014). Some of these ESD cities understood their activities as processes for developing local ELSDs. This includes amongst others my home city of Osnabrück (see more in Becker 2016 and Sect. 5). Such ELSDs should either be a preferably integrative part of possibly already existing educational landscapes or be closely connected to local activities aiming towards sustainable city development either currently or in the future.

[16] http://www.uil.unesco.org/lifelong-learning/learning-cities.

[17] http://www.uil.unesco.org/lifelong-learning/project/learning-live-sustainably-role-cities. As a representative for the ESD City of Osnabrück, the author participated in this workshop, whose participants were mostly from Europe and North America.

The local level is of utmost importance for successful climate policies (see Sects. 1.2 and 1.3). Also here, it is a matter of linking as many actors as possible in a network, of cooperating with communal politicians and administrations as well as business enterprises that have a climate-friendly attitude, in short, a 'landscape of climate actors'. This landscape should also include the respective educational activities in climate change, and therefore CCESD. In most German cities, such linking seems to unfortunately play a minor role.[18] One positive example is the vision of the internet portal for CCE of the big German city Cologne: 'Development and establishment of a value-added chain education by including all age groups, relevant professional aims, private and public fields of action as well as economic sectors.' (translation of the German original text).[19]

Through such linking, various community networks, synergy effects for climate protection, sustainable development, ESD and education in general and therefore also for CCESD can be achieved. Good results can be best achieved if scientists with a transdisciplinary mindset are engaged in the process. Furthermore, this also results in personal opportunities for the citizens, for example, in everyday life, professional qualifications and individual satisfaction (MK NRW 2015, p. 9). The practical barriers of such integrative approaches on the local level are mainly the result of the current conditions in most cities in Germany. These conditions include limited finances, strictly separated responsibilities and often a lack of interdisciplinary competences in the administration. In this article, most considerations for a local approach are not only valid for cities but for all municipalities as well. On one hand, the difficulties in implementing strong networking and cooperation in cities can grow with their size. On the other hand, bigger cities and especially those with an urban character offer a greater variety of actors and opportunities for implementation and engagement.

4.3 'Glocal' CCESD: Subjects, Action Areas and Perspectives

At the content level, there is a broad spectrum of actions and subject areas on climate change and the related perspective of SD for all educational fields—even for informal learning (see Sect. 2):

[18]Projects from other cities are beyond the scope of the current article. Up to now, there has been no national survey of climate education in cities (see Osnabrück in Sect. 5). In May 2017, the author started an initiative for surveying the award-winning German ESD communities, which should serve as a basis for exchanging experience and joint perspectives as well as make a contribution to the Global Action Programme ESD.

[19]See http://www.klimabildung-koeln.de/klimaschutz-bildungskonzept?sess=f0c444db3730f6d8436a857df95b76e8 (29.6.2011). So far, no information is available on the permanent implementation and effectiveness of this project.

- Climate-friendly mobility, e.g. local/urban public transport, bicycle traffic, pedestrian flow, innovative traffic management, carsharing, climate-friendly holidays
- Climate-friendly construction and housing, e.g. building insulation, application of renewable energies, energy efficiency, energy counselling
- Climate-friendly conception of town planning, greening process of city areas, city nature, local recreation and leisure in city districts, …
- Climate-friendly consumption, e.g. purchasing and using sustainable products and services (efficiency), sustainable disposal, ecologically fair procurement system
- Climate-friendly nutrition, e.g. fewer animal products, organic products, fresh, seasonal, regional products ….[20]

These subjects should always be approached with respect to the local/regional situation and possibly also in consideration of the global aspects, expressed in the newly created word 'glocal'.

In addition to examining such topics, CCESD has to teach general basic knowledge on climate change and possible management strategies: climate research and the greenhouse effect (natural systems, local and global contexts, anthropogenic influences), history of energy, national and international climate policies, renewable energies and future technologies and climate fairness. CCESD will always have to relate to possible and necessary political, social and also cultural consequences—particularly on the local level. In so doing, CCESD will always be related to political, social and cultural education in the end. In any case, creative, target-group-related and diverse participatory offering about the relevant subjects should be developed and implemented and related as much as possible to the respective local situation and concrete everyday action. There is a wide range of tested methods and examples for practical implementation of climate education at school, vocational training, continuing education or studies.[21] The informal area of educational landscapes is also of major importance and includes the following formats:

- A different range of services for counselling (on changing behaviour, planning aids and an overview of possible subsidies).
- Conferences, workshops and expositions (for exchanging information amongst experts and providing information to the interested public).
- Regulars' reserved tables at restaurants (German: *Stammtische;* as regular meetings for linking groups of actors).

[20]Possible references to the various educational areas can be found e.g. in MK NRW (2015, pp. 12–13).

[21]A selection of German and English literature on CCESD can be found in the above-mentioned literature database BNELIT of the author.

- Public relation events and campaigns for initiating and anchoring the process of climate protection in the population, for reinforcing the atmosphere of change and the identification with the overall process.
- Cultural events during which measures of climate protection are practised and communicated or which use their profit for climate protection measures.
- And last but not least, central local websites which inform the public about activities and models of good practice.

The whole institutional approaches mentioned in this section are gaining a broader basis in local educational landscapes through cooperation and networking: In schools and other educational institutions, learners are getting significantly more as well as new opportunities to gain insights into everyday practice. In recent years, some publications related to this have been published: In a state-funded project, examples of experiences regarding cooperation between the local climate protection and local ESD actors were appraised and recommendations were formulated (ANU 2013). Another good example is the very successful practical guideline about 'Education in communal climate protection' (MK NRW 2015), which was developed by the Government of North Rhine-Westphalia in close cooperation with many interested actors in the field of education and climate protection and representatives of community administrations.[22] The comprehensive concept developed by the city of Cologne and its respective internet portal (http://www.klimabildung-koeln.de) is a positive example of how such work may succeed. It is interesting to note that the project was financed to a large part by Cologne's municipal enterprises, which although certainly welcome, is certainly neither an ideal nor transferable solution (see Jantz 2016).

4.4 Problems of Local CCESD in Cities

Considering the abundance of crucial and challenging tasks that are nevertheless difficult to put into practice, we are faced with the problem of how they can be implemented in cities and other communities. Comprehensive and holistic local CCESD approaches in the outlined sense (Sects. 4.2/4.3) are apparently far from being implemented in a necessarily broader and long-term practice. This is the case even in those regions included in the present Masterplan 100% Climate Protection. The general political problem in Germany is that such CCESD approaches were not explicitly included in the previous state-funded programmes in Germany.

Behavioural changes in individual action areas, which can perhaps be achieved or promoted through climate education, will not suffice in the long run. Comprehensive forms of forgoing or frugality (sufficiency), namely, different

[22]The basic ideas of this practical guide (40 pages), on which the author collaborated, largely agree with the argumentation in this article. The implementation possibilities and the content aspects are comprehensively presented in the guide.

lifestyles, will have to be developed and implemented by as many people as possible. Often, this is difficult to enforce in Germany and other industrialized countries and also constitutes a great challenge for practice-related CCESD on site.

Kopatz (2016) explains in his book that the behaviour of all of us is more strongly influenced by established legal standards than by mere moral appeals. He would like to 'change structures instead of persons'. This, however, is no alternative: both structures as well as persons must change. Without CCESD in a wider sense, there will be no real change in structures. Also, these new structures must be plausible for the citizens and the following generation if they are to function effectively. Naturally, this framework also includes climate-friendly economic policies and mobility policies at the national and local and/or regional level. Through clever measures, the climate-friendly action of citizens can be facilitated. This also concerns all administrations, enterprises, educational institutions, organizations and others which may improve the conditions for climate-friendly behaviour by appropriate measures in their fields of actions.

Nevertheless, it is difficult in many cases in our democratic society to come to any agreement at all regarding sensible political measures. In particular, politically influential economic interests often prevent, weaken or delay these measures, which will especially have dramatic consequences for the climate change. In addition, it would be a contradiction to democratic forms of education if the declared aim was a clearly determined correct type of behaviour in all fields of action. In most cases, there is no clear-cut correct behaviour anyway in this very complex social field, which does not imply any arbitrariness of action. Finally, even a successful and socially accepted CCESD will not be able to guarantee a sufficient change in the citizens' behaviour. Even an acquired disposition for climate-friendly behaviour does not guarantee a practical implementation. It will be even less efficient when applied to many spheres of daily life and behaviour that are often characterized by old habits and convenience, emotions and many other factors.

However, there is reason to believe that the local approach of education in educational landscapes in cities and the link to possibilities for action on site increases the probability of diverse forms of practical action in favour of climate protection and a more efficient form of cooperation. Publishing works on practical successful approaches on site and engaging in practical cooperation may increase the motivation of individual actors and thus reinforce the positive effects overall.

5 On the Way to Becoming the Climate City of Osnabrück

Normally, the creation of local educational landscapes for sustainable climate development is a long-term process, in particular, as long as no overall planning or coordination is available. Nevertheless, over the years, important experience-based foundations are set. In this sense, the following section provides an overview of the City of Osnabrück. Approximately 30 years of experience in the process of developing and linking environmental education and ESD have shaped the strategy

outlined by the author in this article. Perhaps a unique opportunity for developing an efficient CCESD will be the current 'Theme Year 2017 Climate City Osnabrück', which will be shortly discussed at the end of this section.

5.1 Historical Review

A first evaluation on climate development in Osnabrück was conducted as early as 1986. In 1994, the city of Osnabrück joined the international European Climate Alliance (see Sect. 1.2). Later, numerous initiatives and projects were developed with the aim of climate protection, of which the following are particularly worthy of mention[23]:

- Annual C02 balance of the city administration
- Establishment of a 'Round Table CO2'2001: The city of Osnabrück joins the European Land and Soil Alliance (ELSA), which in 2009 declares 'Soil protection is climate protection'[24]
- From 2005: Development of a cadastre for the potential of solar roofs in the city of Osnabrück by aerial photographs (http://geo.osnabrueck.de/solar/)
- 2009: Employment of a manager for climate protection to implement the various measures decided upon in the city's first climate protection concept from 2008
- 2009–2016, the project 'Energy Efficiency Check' to support low-budget households in their efforts to save energy.

By 2009, many persons committed to climate protection had criticized the fact that the city lacked an overall concept of climate protection which joined all actors engaged in climate protection in a participatory manner. For this reason, the Osnabrück Climate Alliance (*Osnabrücker Klimaallianz*; O.K.) was founded by more than 20 non-governmental organizations (http://www.osnabruecker-klimaallianz.de/). The members started from the assumption that it would not be possible to achieve sufficient climate protection and energy transition by the climate-friendly action of the communal administration alone. In addition, this would require a lot of motivation, a positive guiding concept ('climate city') as well as an open debate on the very different positions of all the actors.

The members of all different working groups contributed their own knowledge to these somewhat controversial discussions, which lasted over several months. In discussions with the city administration after considering the models and experience of other cities, a booklet was produced in the end *On the Way Towards Becoming a Climate City* (O.K. 2012), which included chapters on the following subtopics:

[23]See http://buerger.osnabrueck.de/public/index.php?l=&mr=1000&p=622 and https://www.osnabrueck.de/fileadmin/user_upload/Klimaschutz_Energie_Meilensteine__P004671853_.pdf.

[24]European Land and Soil Alliance (ELSA) e.V. Soil Alliance of European Cities, counties and communities: By the way, the European office is in Osnabrück (http://www.bodenbuendnis.org).

- Energy saving—basics of climate protection
- Renewable energies—Osnabrück' regenerative energy supply
- Mobility and city planning—urban quality of life
- Nutrition, supply, waste reduction—critical consumption
- Climate justice and education—climate protection as a social subject.

Unfortunately, only a few educational actors participated in the Osnabrück Climate Alliance. Therefore, this booklet gave a very low priority to comprehensive education. All in all, the results of all efforts and the publication had a strong positive impact on the climate policies of the city. The strong engagement of the OK was the primary contributing factor in Osnabrück's successful application to participate in the support programme Masterplan 100% Climate Protection from the German Federal Ministry for the Environment, Nature Conservation, Building and Nuclear Safety. A major part of this masterplan was the establishment of 10 evaluations on climate-protection-related subtopics. However, the important aspect of education was not considered and could only be included to a small extent first in 2016 after tedious applications to alter the original proposal (see Sect. 5.4). The successful work in the field of climate policies in Osnabrück was also reflected by several awards, for instance, being included into the network '100% Renewable Energy Regions', category '100ee urban' in 2012.

Yet generally it is difficult for a city to achieve ambitious climate protection goals. Therefore, it was very helpful that also the rural district of Osnabrück, the neighbouring town of Rheine as well as the neighbouring district of Steinfurt participated in the Masterplan 100% Climate Protection and established a close cooperation within the area of climate protection in this large region (see Sect. 5.5).

5.2 *Energy Saving at Schools and Climate Change Education (CCESD)*

Already in 1993/1994, the concept of energy saving at schools had been developed in the Association for Ecology and Environmental Education Osnabrück (AEEEO) —*Verein für Ökologie und Umweltbildung Osnabrück e.V.*[25] The 'Modell fifty-fifty' granted schools a direct share of the savings as a financial incentive.[26] Although the project had been very successfully implemented at the six

[25]For nearly 30 years, the association has carried out many projects and services (see http://www.verein.umweltbildung.de). The concept of the association and its projects is oriented along the overall principle of education for sustainable development. It has received 4 awards from the German Commission of UNESCO within the framework of the World Decade Education for Sustainable Development and of the subsequent ESD World Action Programme.

[26]At that time, this model had already been started in Hamburg. In the meantime, it is being practiced at thousands of schools nationwide in Germany. See for example http://www.fifty-fifty.eu/ or http://www.energiesparmeister.de.

participating schools over a period of two years, unfortunately, it could not be continued because the local administration stopped the financial support. Finally, 10 years later, the AEEEO started a similar project 'Educational Consulting on Energy Saving at Schools' on behalf of the City of Osnabrück. This was a result of the development of the first concept for climate protection of the city, whose implementation had been enacted by the City Council in 2008. Since 2012, this project was continued by the AEEEO with additional support from the Federal Ministry of Environment (BMUB). From this time, a pedagogical premium model was employed that considers all school activities related to energy saving and climate protection. In this context, 'energy managers' are trained in all classes, pupils who receive credit points based on completing a questionnaire that forms the basis for calculating the annual premium paid to the school. In the meantime, nearly all primary and special schools have participated in this project and have received a premium once or several times (www.pe-os.de). Naturally due to its limited content, this project has only constituted a small contribution to CCESD. The city as the contracting authority is not 'just' concerned with energy saving as a contribution to climate protection but also seeks to conserve the communal finances (through reduction of CO2 emissions and energy costs). This is clearly seen in the annual energy reports of the city, such as the one from 2016, which are based on decisions of the City Council. Since 2016, the project has been extended to all Osnabrück schools and since 2017 on a permanent basis through financial support from the Osnabrück city administration. The AEEEO intends to develop and extend the concept in the direction of a local landscape of CCESD (see Sect. 4) starting in 2018 and to convince the city administration and the municipal politicians of this idea (see Sect. 5.4.)

Besides this long-term project, a smaller number of short projects are dedicated to energy saving, which were initiated by the city administration (e.g. at daycare centres). Finally, there are also many projects in schools and other educational institutions, organizations, facilities and associations, which function in an independent manner and are not all generally known to the public.

5.3 *On the Way Towards ELSD in Osnabrück Since the Mid-Eighties*

Irrespective of the projects described in Sect. 5.2, the city of Osnabrück is characterized by an increasing number of activities in the field of environmental education and third-world education that started as early as in the mid-eighties and were later developed towards ESD. Early on, attempts were made to link these in a network, which to this day remains a challenging task due to the limitation of resources. One such attempt is the Municipal Centre of Environment Education (*Umweltbildungszentrum*; UBZ), founded in 1997, which is situated in the city, in contrast to most other institutions of this kind, and primarily concentrates on

city-related topics. In 2002, some cooperation partners of the UBZ founded the open Working Group Environmental Education (WG EE) of the Local Agenda 21 Osnabrück (the Local Agenda 21 was founded in 1994). The WG EE increasingly took over this network function (see http://www.ak.bne-osnabrueck.de).[27] This included organizing annual themes and competitions for children and young adults on the following subjects related to Osnabrück: Local Agenda 21, water, nutrition, living and housing in the city, nature in the city, mobility and climate city (see Sect. 5.4).

As early as in 2011, concepts and plans were developed in Osnabrück for a first kind of educational landscape on an important subject of sustainable city development: urban flowing waters. The name of the most important river is the Hase, and for many years, projects were carried out by the network 'Schools for a Living Hase' and competitions held for its revitalization. All these efforts were carried out by the AEEEO in cooperation with the city administration of Osnabrück (http://umweltbildung-os.de/hase and http://www.lebendige-hase.de). A fundamental extension under the name 'Educational Network Living Hase' involved the cooperation of some actors from the whole region along the entire Hase River and beyond the city limits. Furthermore, inclusion was considered to be an important pedagogical principle. A number of scientists from different faculties of the University of Osnabrück worked on the concept, which was also supposed to be implemented with their support. However, this challenging and elaborate project of establishing a theme-specific local education network failed due to negative responses from the addressed foundations. The idea of a local education network was continued under the term educational landscape:

The perspective of a general educational landscape for SD in Osnabrück was backed up by many successful projects in Osnabrück and in its nearer surroundings: The German Commission for UNESCO honoured nearly 50 projects and organisations with an award within the framework of the UN Decade of ESD. The WG EE from the Local Agenda 21 and the AEEEO received a combined total of 9 awards from UNESCO as organizations in recognition of their systematic work and networking in Osnabrück. This provided impetus for both organisations to convince the City of Osnabrück to apply for the UNESCO award as a City of the UN Decade of ESD. Under the aspect of expertise and time management, this was only possible since both organizations assumed the tasks involved in the application. They established and published an inventory of all ESD actors and their projects as well as existing structures of cooperation in a wider sense (http://www.bne-osnabrueck.de). As a first and important result, a 'Sustainability Day' was organized in 2014 by the Local Agenda 21 in Osnabrück 2014. The topic was 'Together Towards a Sustainable City of Osnabrück, An Educational Landscape for Sustainable Development'. This well-attended event was mainly organized along the lines of the method *Worldcafé*. Participants changed between eight 'topic tables' and

[27]This local linkage by networking was the primary reason that the working group was awarded 5 times during the UN Decade ESD by the German Commission of the UNESCO.

interactively discussed different fields of action: nutrition, fair trade, health care, climate protection/energy, culture, living and residing in old age, city development/traffic/mobility and, last but not least, ESD as a cross-sectional subject. On the whole, highly interesting results and ideas for the future were produced as a result of these diverse and intensive discussions.[28]

Quite soon, it became evident that most participants and participating organizations lacked the necessary financial and human resources to implement the many ideas and suggestions from Sustainability Day 2014. An even more aggravating problem was the fact that the city administration quite unexpectedly introduced extreme household cuttings, specifically with regard to the Local Agenda 21 Osnabrück. This reveals a basic structural difficulty in communal policies: lack of financial resources and setting communal political priorities in which insufficient priority is assigned to education and ESD. This was true in spite of the community projects of the Germany-wide project 'Learning on Site' (*Lernen vor Ort*),[29] which also employed the term educational landscape. The practiced cooperation with the ESD actors had narrow limits, however, because the work of the Learning on Site projects focused on social challenges arising in the context of education at school.

The Sustainability Day and the envisaged networking with the aim of supporting ELSD did not lead to many feasible results, apart from the implementation of some proposals by the WG EE, an initiator of Sustainability Day. At the end of 2015, the WG EE changed its name to Working Group Education of the Local Agenda 21 Osnabrück (WG Education). The guiding principle for ESD, which has existed since 2002, was not changed.[30] What is particularly worth mentioning here is the organization of the new event Dialogue Forum ESD (since 2015), which primarily is aimed at ESD actors from all educational areas with strong commitment. Intentionally, very different subjects were chosen to give incentives for subject-related cooperation and networks that go beyond the frame of the discussions (http://www.bne-osnabrueck.de/dialogforum):

1. Nutrition education for SD (with the WABE Centre for Nutrition[31])
2. Teaching sustainability in daily school life—but how and with whom? (with the Education Office of the City Administration Osnabrück and its Learning on Site projects)
3. 'More consumption = more car traffic = more environmental problems?!' (with Hellmann Worldwide Logistics in Osnabrück)

[28]For more information, see http://www.bne-osnabrueck.de/nht2014/, including a documentation of the results of the City of Osnabrück.

[29]This project that lasted over several years was promoted in 40 cities and districts by the Federal Government of Germany.

[30]According to the guiding principle of ESD, decided upon in 2005, the WG Environmental Education decided in 2015 to change its name to 'WG Education' of the Local Agenda 21 for Sustainable Development Osnabrück.

[31]'WABE-Centre for consumer information, nutrition, sustainable food production and post-harvest technology' at the University of Applied Science, Osnabrück.

4. Immigration and refugees: Challenges and opportunities for any kind of educational work (together with refugee organizations in Osnabrück)
5. Climate City Osnabrück—Climate Change Education (CCESD) (with Masterplan 100% Climate Protection from the City of Osnabrück)
6. The rights of all older people in less-developed countries as a subject of global learning in Osnabrück (with the association HelpAge—a global organisation promoting the right of all older people)
7. With education towards climate-friendly behaviour? (June 2017, with the University of Osnabrück and other associations).

In preparation, subject-related partners of cooperation were being identified that were mostly outside the inner circle of ESD actors, which made for interesting discussions. Further contributions of the WG Education towards developing an educational landscape consisted of sponsoring frequent radio programmes for one hour with a local radio station as well as establishing an ESD newsletter to provide information to a wider range of local ESD actors and other interested persons as well as administering the website www.bne-osnabrueck.de. As most tasks are even now still accomplished through voluntary work, it is unfortunately not possible to do more networking.

The 7th Forum was the second Forum on CCESD—after the 5th Forum about Climate City and CCESD Osnabrück in 2016. The various scientific and practice-oriented lectures were the basis for a lively discussion among the participants from differing educational areas. The focus was on the fundamental question of how the numerous economic, social, political, cultural, psychological and other barriers to climate-friendly behaviour can be better overcome through suitable forms of CCESD. Only brief consideration was given to the question of how the local social environment can contribute to overcoming these barriers. A well-developed local educational landscape offers various learning possibilities for different people. Numerous climate activities/actions can serve as a model or encourage practical participation on a local level. Finally, political measures are also able to facilitate climate-friendly behaviour. These are the long-term tasks of Learning Cities, which well deserve this designation. An additional outcome of the discussion of the 7th Dialogue Forum ESD was some ideas about strengthened cooperation, which is a topic for further discussion at the next Dialogue Forum.

5.4 Climate Change Education and the Theme Year 'Climate City 2017'

The successful project 'Climate City Osnabrück' as mentioned in Sect. 5.1 motivated the former WG EE to start dealing with CCESD as early as 2011. Also, the Masterplan 100% Climate Protection of the City of Osnabrück, planned for 2012, appeared to be a good opportunity to deal with this issue. The subject climate protection was to be launched in the same format as successfully proved in the

previous ten years: as a so-called *Agenda Competition* for children and young adults, combined with a diverse event programme for different target groups – now on the thematic area 'Climate City Osnabrück. Unfortunately, as already mentioned in Sect. 5.1, this project could not be started in 2014/15 as planned due to the lack of financial support for educational work in the budget of the 'Masterplan 100% Climate Protection' of Osnabrück. This structural political problem was already mentioned in Sect. 1.3 for the national level and in Sect. 5.1 for Osnabrück.

Finally, in Spring 2016, the preparations for the 7th Agenda Competition 'Climate City' could finally be started. With the term 'Climate City Osnabrück', a term was intentionally selected that was easy to communicate and had already been in the focus of public attention during the publicity of the Osnabrück Climate Alliance 2011/2012 (see Sect. 5.1). The focus was on the perspective 'Education as a Means of Osnabrück Becoming a Climate City'. All well-known and potential actors were asked to contribute to the design of a framework programme on this subject or on the more general subject 'Climate City for Interested Citizens'. In order to increase the effect, it was proposed that Local Agenda 21 conduct a Theme Year 'Climate City' for 2017, a project agreed upon at the end of 2016. At the same time, this project was supported by the Osnabrück Masterplan 100% Climate Protection and its advisory council, which included representatives from economical institutions, alliances, associations, research, churches and six expert teams. Also, cooperation was established with the project Climate Ambassadors (*Klimabotschafter*) of the city and the regional district of Osnabrück (www.klimabotschafter-os.de). A new website www.klimabildung-os.de was launched by the WG EE in close cooperation with the AEEEO as a medium of information which includes all relevant information on the subject. In a colourful mixture of planned or past one-off events, these include, for instance, films about climate change, civic dialogues about the change in traffic policies in Osnabrück, puppet shows for young climate protectors, a workshop for sustainable mobility behaviour, an energy fair 'Energy Concerns All of Us', panel discussions with representatives from the political parties' councils on climate protection…. This also includes the award ceremony of the 7th Agenda Competition, to which once again, very different contributions from the entire range of addressees had been submitted and were awarded different monetary and non-monetary prizes based on the quality of the contributions. As in previous Agenda Competitions, the contributions are permanently published on the website www.klimabildung-os.de to provide information and ideas to future actors, also at a much later date. The Annual Programme Becker 2017 is still taking place. The Civic Dialogue Change in Traffic, for instance, will still organize several public events on different subjects. At the end of 2017, the Dialogue Forum ESD will draw up a balance of the Theme Year 'Climate City', and develop possible perspectives for CCESD in Osnabrück for 2018 onwards.

5.5 *Perspectives of CCESD in the City of Osnabrück and the Region*

To gain a long-term strategic perspective, it is necessary to systematically examine and link all the local concepts of climate protection/climate policies and educational landscape for sustainable development (ELSD) on the subject of CCESD. In deciding which of the many possible and beneficial tasks to implement in Osnabrück, focal areas need to be set that are in line with the Osnabrück actors' options as well as the specific conditions. Furthermore, tasks and activities should also be chosen with the aim of fostering synergetic effects among activities on related topics

Overall, the Theme Year 'Climate City Osnabrück' might offer unique and excellent opportunities to work towards the envisaged perspective. At the same time, it significantly contributes to the overall educational landscape of Osnabrück as an example of an area of activity that is considered of great importance due to its thematic cross-sectional function—also for other communal fields of action (e.g. social, cultural, …). If it succeeds, it might even assume a model function at the supra-regional level under the aspect of participatory, networked, communal climate policies oriented towards education.

The state of the development of the Osnabrück landscape for climate education for sustainable development described previously and its possible perspectives are shown simplified in the following figure: In the middle, one can see the primary actors of the Theme Year. On the outer edge, most of the other current or potential actors and groups of actors are shown. The arrows symbolize the current or potential interconnections among the actors or connections to a joint goal (Fig. 2).

There is still a mostly unutilized but very important potential for CCESD in the cooperation of the district of Osnabrück with the two neighbouring regions, the town of Rheine and the district of Steinfurt, which are also included as regions of Masterplan 100% Climate Protection. Close cooperation between a big city and the surrounding countryside makes it easier to achieve necessary and self-specified climate protection goals. CCESD also appears to have too little significance in all the neighbouring regions. As mentioned before, this deficit is due to the German government's construction of a promotional programme that hardly considers education at all and allocates only limited funds for public relation measures and 'processes of civic society'. In May of 2017, the theme of the annual meeting of these four neighbouring regions was 'Climate-friendly Mobility'. Fortunately, in 2018, the theme will be education-oriented: 'Climate Protection with and for Young People'. This is a good opportunity for local CCESD and the networking among the actors to gain in importance in the four neighbouring regions.

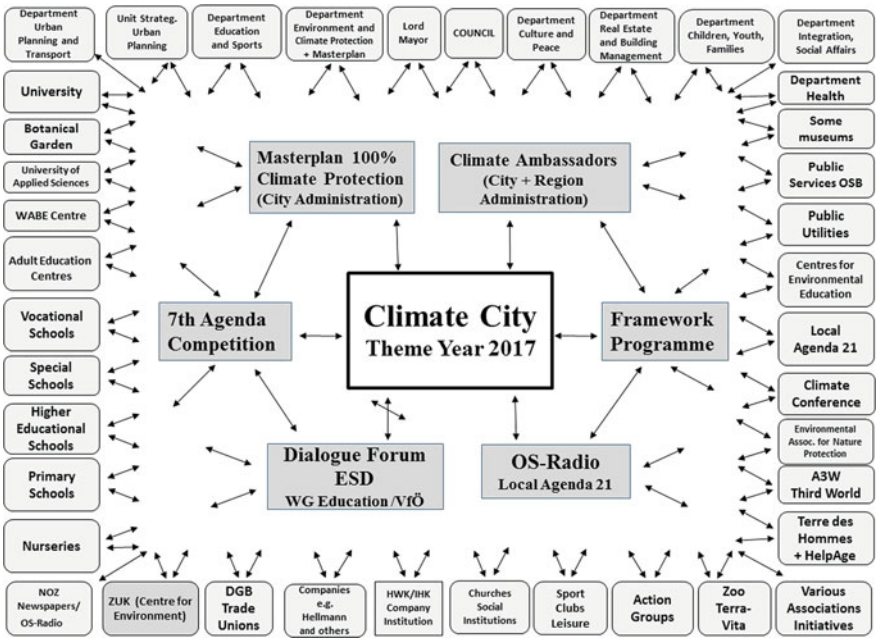

Fig. 2 G. Becker: Educational landscape for climate change education Osnabrück—potential and process 2013–2017

6 General Conclusions

This article has shown that climate change education for sustainable development (CCESD) can make a necessary and important contribution towards addressing the climate crisis in terms of climate change mitigation and adaptation. The prerequisite is local or regional educational landscapes that are closely linked to climate-relevant activities from local politics, civil society and also the economy However, it is also apparent that CCESD is still very much at a beginning stage due to myriad reasons and has its limits under the current socio-political conditions. This was also shown by the example of Osnabrück, which was covered here in detail. To promote these local perspectives, especially in the urban sphere, additional changes are required in climate and educational policies at the various levels. At the same time, it is important for the actors to exchange information on the local, national and international levels, which in turn should improve the local approaches, further developing them and spreading them to new municipalities. Furthermore, climate science or sustainability science needs to assume a transdisciplinary perspective in the future to support and stimulate the field: Knowledge from education, environmental psychology and environmental economics all play a vital role. Future research projects to study the specific urban educational landscapes with respect to future climate cities are of great importance.

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Institutional Management and Professors' Perception in the Strengthening of Education for Sustainability

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Abstract Education for Sustainability (EpS), with its focus on transformative approaches, focused on integrating sustainable principles in a multidisciplinary way, enriches the learning and teaching of the Business Administration. In this sense, its effectiveness will only be possible as long as institutions and professors rethink their roles as agents of change. In this way, the present study aims to identify the perceptions of professors of the Business Administration Graduate Programs in Stricto Sensu of Rio Grande do Sul regarding EpS, as well as to identify the management practices and policies of these programs related to EpS. In this regard, six of the nine Master programs in Business Administration in Rio Grande do Sul were surveyed. In terms of methodological procedures, a descriptive and exploratory qualitative research was carried out. For data collection, interviews were carried out with program coordinators, aiming at identifying concepts about the management of Sustainability programs and also with professors from different lines of research, aiming to identify Sustainability concepts, teaching strategies and methodologies of sustainability and learning. Altogether, sixteen professors and coordinators were interviewed. The results indicate that the Graduate programs do not have incentives for sustainable management and the conceptions of the professors are private, having a relation with the line of research in which they are

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linked and not with the Graduate Program. In this way, it is analyzed that the scenario is still subject to improvement, especially regarding sustainable management, aiming the development of management policies that seek to promote the awareness of professors as trainers of citizens.

Keywords Education for sustainability · Postgraduate studies · Professors Sustainable development

1 Background

From the recognition of the consequences of the current development model, there is a deepening of the environmental problem, linked to the reflection of the influence of society in this process, which led to a new concept called Sustainable Development (SD). According to Lauder et al. (2006) education is an important tool for the preparation of individuals for a sustainable society. In this work, Education for Sustainability (EpS) is characterized as the educational processes necessary to promote sustainable development and improve people's ability to understand the problems of the environment and development (ONU, 2015).

Along the same line of reasoning, Tilbury (2004) states that EpS will only be viable as institutions and professors rethink their roles as agents of change. Therefore, in order to have business professionals with more participative and holistic views of society, it is necessary to think about the courses that form administrators, managers and professors in the area and whether these professionals are being stimulated in the formation of their critical thinking and attuned to the needs of the labor market in order to prepare them for a sustainable future. In this way, master courses need new components with sustainable perspectives, focused on responding to the needs of the environment in which they are inserted.

According to the Association of Postgraduate and Research in Business Administration (ANPAD 2017), there are 108 Associate Business Administration Graduate Programs, training more than 1000 masters and doctors annually in Brazil, and, therefore, to verify how Sustainability is treated in the graduate courses in Business Administration becomes important.

In the state of Rio Grande do Sul, located in the extreme south of Brazil, with a population of approximately 11 million inhabitants (Fee 2015), there are twelve Postgraduate courses in Administration, three professional master programs and nine academic programs (CAPES 2017). It is through these academic programs that the formation of future professors of undergraduate courses in Business Administration takes place, which will have as goal the teaching and the qualification of professionals who manage companies, coordinate projects, are civil servants and that will influence the society as a whole. It is also worth mentioning that these programs are in the expansion phase in the state.

Thus, the present study aims to identify the perceptions of professors of the Stricto Sensu Post-Graduation Programs in Rio Grande do Sul regarding EpS, as

well as to identify the management practices and policies of these poograms related to EpS. Thereby, the object of the study, the master courses in Business Administration of Rio Grande do Sul, can provide subsidies to other programs in other states, given the representativeness of these programs within the national scenario.

2 The Importance of the Education for Sustainability

The concern about quality education in order to deepen the teaching of Sustainable Development, in an integrated and interdisciplinary way in school curriculums is one of the concerns of the Decade of Education for Sustainable Development. Through a multiplicity of methods, the UN intends to develop the critical and resolute thinking of society with the intention of proposing questions about the current context and the possibilities of improving the relationships between the social, environmental and economic plan of the community in which we are inserted (UNESCO 2007). In addition, there are the 17 global objectives that the UN determines as necessary for the promotion of Sustainable Development and one of them is related to quality education and how to promote this education in favor of the Sustainable Development (ONU 2015).

Also according to UNESCO (2007), Education for Sustainable Development requires a new educational approach and new learning spaces. These spaces include formal education, technical and professional training, professor training, higher education, among others. UNESCO (2007) states that universities are one of the actors and partners to develop EpS. This is na important partnership for the development of alliances and generation of knowledge, generating enduring skills to the university community that makes it possible to be applied in the reality of each person, contributing to sustainability.

To implement sustainability in universities, Fouto (2002) believes that there is a need to promote education as an element for the promotion of ethical values and behaviors capable of contributing to the training and training of the actors involved in the process. Fouto (2002) still mentions the importance of including: (i) sustainable internal procedures; (ii) faculty environmental training; (iii) awareness of the population involved in the practice of Sustainability; (iv) dissemination of the knowledge generated inside and outside the walls of the institution; (v) encouraging research with a view to Sustainable Development in an interdisciplinary way; (vi) commitment of all those involved in ethics and social responsibility; (vii) formation of partnerships with other universities and sectors of society.

So, higher education can be considered as an important tool to work on sustainable development, and it is the moral responsibility to contribute to development in order to create conditions for sustainability to occur (Wass et al. 2012). Sterling e Thomas (2006) believes that one of the main characteristics of EpS is its holistic and integrative component that makes the educational elements converge

for Sustainability. Springett and Kearins (2005) point out five characteristics of Education for Sustainability:

- Interdisciplinary and holistic;
- Guided by values;
- Promoter of participatory action through critical thinking and problem solving;
- Fulfilled from a multi-method approach involving different teaching methods;
- Supported by inclusive and participatory processes.

Jacobi (2003) believes that it is necessary to create a supportive environment that facilitates the Sustainability education process by supplying data, developing and disseminating indicators, in order to make transparent the procedures that guarantee the means to create lifestyles and promote an ethical conscience that questions the current model of development.

In this context, training for Sustainability Education is being discussed by international organizations such as the *United Nations Economic Commission for Europe* (UNESCO 2012) Eight countries and fifteen universities came together and developed the project "Competencies for ESD (Education for Sustainable Development) professors" (Sleurs 2008). In the competency training model proposed by the project, five domains or categories are identified: (i) knowledge; (ii) complex thinking; (iii) emotion; (iv) ethics and values and (v) action (Sleurs 2008).

The **knowledge** domain involves conceptual knowledge, factual knowledge and knowledge related to action. They must be oriented to the EpS according to time (past, present, future), spatially (local, global) and must be interdisciplinary. Knowledge is built individually and socially, it relates to the experiences that each person experiences and thus considers social learning. This category, within the scope of EpS, refers to knowledge about social and environmental issues and/or problems, as well as to the occurrence of environmental problems. In addition, it is linked to individual and collective actions that help to prevent environmental problems capable of generating a vision of Sustainability, Sustainable Development and solidarity.

The **complex thinking** category is linked to the fact that analytical and reductionist thinking is insufficient to solve today's complex problems, which requires a systemic view. This can help to understand, therefore, the teaching and learning of the concepts about Sustainability.

The **emotion** category refers to issues involving the affectivity of individuals. Emotion is an inseparable affective component of rational thought and, in this sense, of intelligence. Excitement in contemporary sciences and societies has long been and still is in many cases forbidden. The attitudes of thinking, reflecting, valuing, making decisions and acting are inextricably linked with emotions. Emotional competence is inseparable from EpS, and empathy and compassion play a key role in developing this competence.

The domain of **ethics and values** is a category that identifies itself with behavior. Values are identified as beliefs, attitudes or convictions that are reflected

in personal behavior and are influenced by a variety of factors, such as: gender, culture, ideology and personal life experiences. Individually or collectively, values determine what should or should not be done, and doing what is right or wrong, it is what should be understood by ethics. Social justice is also related to this domain, because ethical values and principles are fundamental for building a fair and sustainable society.

The **action** category refers to the process by which the competencies of the other four domains interact to allow the creation and development of significant and socially and environmentally relevant projects through collective work. In doing so, one can apply the acquired knowledge, use the complex thinking and the systemic vision to understand the socio-environmental dynamics; dealing with emotions and being aware of the moral and ethical values that exist in different cultures. Thus, actions need attitudes, practical skills and competencies in the area of management to be carried out.

3 Method

In compliance with the proposed objectives, the research is classified as descriptive-exploratory. According to Gil (1999), exploratory researches has as main objective to develop, clarify and modify concepts and ideas with the intention of formulating more precise problems for later studies. Roesch (2005) believes that descriptive research has the primary objective of obtaining information about a particular population or phenomenon. The methodological option of the study was the qualitative approach of theoretical-empirical nature. According to Deslandes and Minayo (2010, p. 17), "qualitative research responds to very particular questions, because it works with the universe of meanings, motives, aspirations, beliefs, values and attitudes."

The subjects of the analysis are related to the Business Administration Graduate Programs in Rio Grande do Sul. There are nine master degrees in Business Administration on academic approach at: Federal University of Rio Grande do Sul (UFRGS); Business Administration Graduate Program of the Pontifical Catholic University of Rio Grande do Sul (PUC/RS); Vale dos Sinos River (UNISINOS); University of Caxias do Sul (UCS); Federal University of Santa Maria (UFSM), University of Passo Fundo (UPF); University of Rio Grande Foundation (FURG); Meridional College (IMED) and University of Pampa (UNIPAMPA). In order to collect the primary data, the following techniques were used: semi-structured interviews conducted between February and June 2016 with the coordinators of the Graduate Programs and with the professors, preferably the leaders of the areas of each Business Administration Graduate Programs research line.

The seven programs interviewed were selected in order to obtain visions of programs in different regions of the state of Rio Grande do Sul, thus, seven programs were interviewed so that each region was represented. The interviews were

carried out with the Business Administration Graduate Program of the following universities: UFRGS; UNISINOS; UCS; UFSM; FURG, IMED and UNIPAMPA.

Five coordinators of the master degrees and 13 leaders of the research line were interviewed. For the purpose of collecting data from the interviews, the coordinators of the Graduate Programs were interviewed both as coordinators and as representatives of the lines of research in which they work. The initial contact took place electronically, in which an e-mail was sent with a brief explanation of the research objectives, in conjunction with an invitation to participate. In order to make the study participants more comfortable, the interviews were configured in different ways: seven were conducted in person and eleven were given through the Skype program. Table 1 shows the subjects of the research.

Table 1 Interviewed by Program and Research Line

Program	Concentration line or research	Identification of the respondents
Business administration graduation program UFRGS	Finances	Not interviewed
	Human resources	Not interviewed
	Systems management and TI	Not interviewed
	Organizational studies	A
	Marketing	BC
	Quantitative modeling	C
	Innovation, tecnology and sustainabilty	D
Business administration graduation program UNISINOS	Competitivity and interorganizational relations	E
	Organizational strategies	F
Business administration graduation program UCS	Strategy and operations	G
	Innovation and competitivity	H
Business administration graduation program UFSM	Strategy in organizations	IC
	Human resources and organizational behavour	J
	Economy, control and finance	K
	Systems and market	L
Business administration graduation program FURG	Organizations, market and labour	M
	Management Technologies	NC
Business administration graduation program IMED	Strategic management and relation with market	OC
	Present-day organizational studies	P
Business administration graduation program UNIPAMPA	Organization and development	QC
	Strategy and systems	R
Origin: Elaborated by the authors		

To facilitate the identification of the respondents, the coordinators and professors were classified with the letters of the alphabet from A to R, and the coordinators of the courses were added the letter C after the first letter, indicating their position. One professor did not return the contact and two professors were not interested in being interviewed according to the subject in question. In addition, two respondents were replaced. The coordinator of the university FURG was replaced by the substitute coordinator and the coordinator of the university UNISINOS was replaced by a lecturer of the course and so without the conception of the coordination of the course of that program.

Thirteen of the eighteen respondents have more than fifteen years of teaching experience, demonstrating that they have knowledge about the classroom and the training and management processes within universities. Most, eleven professors, have worked in other universities before being in their current place of work, which may indicate that they already know other scenarios and are more aware of the context in which they are inserted.

Of the interviewees, twelve have undergraduate degrees in Business Administration and twelve have a master or doctorate degree in the same area.

For the analysis of the primary data, five categories were elaborated; it was considered as a references the document *Professors Competences in EDS—a theoretical framework/model for integrating EDS into the curriculum of the professor training institutes—CSCT* (Sleurs 2015). Of these, it was used two of them as study categories: knowledge and action. This option was due to the understanding that these two categories would be more in agreement with the objectives of the work: to understand how the sustainability scenario is through the perception of diverse actors and contexts. The author believes that the knowledge and the way this knowledge is transformed into actions within the programs, may reflect a scenario with greater trustworthiness.

It was also used the authors Springett and Kearins (2005) who presented the objectives of EpS and from these objectives, two categories of analysis were created: the interdisciplinary and holistic view and the innovative methodologies and Fouto (2002) places the importance of Institutional categories for the effective implementation of environmental issues (Category Management). Thus, five categories of analysis were used as reference for the interviews, according to Table 2.

4 Results

In this section, the analysis of the results obtained in the study is presented, the interviews with the coordinators of the courses and with the professors of the Business Administration Graduate Programs are examined. In this way, the perception of coordinators and professors will be analyzed and weights and discussions about the data obtained with the interviews will be presented.

Table 2 Categories of analysis

Categories	Purpose
Knowledge	According to Sleurs (2015) it seeks to analyse the necessary knowledge to understand the environmental problems and that can contribute to the solution or mitigation of the same
Action	It allows analysing the knowledge application, aiming to understand how respondents use the knowledge for the sake of Sustainable Development
Interdisciplinary and holistic view	Identify whether docents are aware of the importance of having a global and systemic vision within the context of Sustainability
Innovative methodology	Identify whether docents work with innovative methodologies to raise sensitization about sustainable issues
Management	Identify policies of the Postgraduate programs in favour of Sustainability, besides the coordinators' view of the courses studied on the subject

Origin: Elaborate by the authors

4.1 Perception of Coordinators

During the interviews with the coordinators, three questions were asked in order to identify how Sustainability is treated as a master policy and not as an initiative of professors. The intention of this analysis is not to go deeper into the question, but rather to obtain subsidies to analyze the initiatives carried out by the professors.

At a first moment, it was sought to identify how the master degree courses put into their programs issues related to Sustainability. The intention was to identify whether there are actions of program initiatives, or whether the actions are initiatives of research lines or specific people. All the interviewed coordinators were unanimous in stating that the programs, as institutions, are not responsible for the Sustainability initiatives that are carried out within the masters. It can be seen that programs can support initiatives, but their origin is not through program management policies. Sustainability issues are not thought in an institutional way. This fact is in line with Fouto's (2002) postulate, which emphasizes the importance of university policies for the implementation of Education for Sustainability in the university spaces.

In addition, it was sought to identify the university's policies on Sustainability and their impact on Graduate programs. The speeches suggest ignorance on the part of the coordinators, by what it is perceived that there must be sustainable issues within the management policies of the universities, but the reflection of these policies is not felt by the coordinators. There are no management determinations to be followed regarding Sustainability by the Graduate Programs.

Thus, a communication gap between higher management and the post-graduate programs is visualized and, in addition, it is important to remember the premises of Jacobi (2003), who believes in the need to create a favorable environment for EpS to promote an ethical conscience that questions the current model of development.

The last point questioned to the coordinators was whether there is a demand for professionals with a profile focused on Sustainability. One of the interviewees was not sure how to answer the question with certainty. However, the other respondents addressed the need for a profile that forms for Sustainability.

It is noticed that in the view of the interviewees there is demand for professionals who are familiar with the analyzed subject. In addition, it was observed in the speech of one of the coordinators that the demand is not only by professionals, students are also demanding to know these concepts. What is evident is that it is not only the demand for professionals, it is also the student and the professional himself who anticipates and seeks the knowledge to reach the labor market with the most conditions to meet the current demands.

The results described demonstrate a difficulty in visualizing the sustainable policies of the universities and the coordinators of the Graduate programs in their actions as managers. It is noticed that the greatest incentive of Sustainability within the Graduate programs are the professors. Thus, in the next section, the interviews with the professors of the researched programs will be analyzed.

4.2 Perceptions of Professors

The interviews with the professors were carried out in order to understand the professors' visions of different lines of research on the theme of Sustainability. Thus, the first point to be analyzed is with regard to knowledge about the concepts of Sustainable Development and Education for Sustainability.

Regarding the concept of Sustainable Development, there was an exhibition without difficulty, all the respondents became aware of its meaning, some having even reproduced the concept set out in the Brundtland Report. With this, it is noticed that although they are professors of the most different lines of research and with a distinct area of performance, most are familiar with the concept, which indicates possibilities of insertion of this concept into several contents in a transversal way.

However, when asked about the concept of Education for Sustainability, the answer was not easy to define. Of the sixteen interviewees, only six felt comfortable talking about the concept. Given the difficulty encountered by the interviewees in defining the terms Education for Sustainability, there are gaps in the discourses on Sustainability. The concept of Sustainable Development is seen almost as a cliche (Lele 1991) and when there is a reference to a somewhat more specific concept, it is difficult to conceptualize it.

The next issue raised, concerns the importance that the professor gives to address principles related to Sustainability in the teaching of master degrees in Business Administration. Some professors have been reluctant to take this approach, expressing doubts about the importance of addressing Sustainability issues in the belief that this approach depends on the context and how it will be inserted.

However, the majority favors the insertion of Sustainability in the teaching of Master degrees in Business Administration.

For those who stated that it is important to address Sustainability concepts, it was asked if they focus on issues related to the theme in their classes. It is noticed that although some interviewees pointed out how important there is difficulty of insertion of Sustainability in the teaching practice of the professor. This difficulty is already pointed out in the literature according to studies by Brunstein, Godoy and Silva (2014), Jacobi (2003) and UNESCO (2007). In the cases identified, the difficulty of insertion is due to two factors: understanding that the concept is not included in the subject in which the professor ministers and it is difficult to identify in which subjects can be inserted questions about Sustainability in the context of a given teaching activity.

Thus, of the eighteen interviewees, six said they did not address the topic, three said they addressed indirectly and nine reported addressing it in their master degree subjects. For those that approach the content of Sustainability, it was asked how they approach it and if there is the use of differentiated methodologies for the teaching of Sustainability. From the answers obtained it was possible to perceive that there is not a lack of different methodologies to do on the teaching of Sustainability, such as technical visits, outdoor classes, stimulation in the realization of extension projects that have sustainability as a focus.

About the interviewees, eight were emphatic in believing in the need to use differentiated methodologies for sustainability teaching activities. These questions are in favor of the purposes of Sleurs (2015) and Cannon (2010) who believe in the transformative potential of differentiated methodologies for teaching sustainability. In addition, a respondent emphasizes that there is no need for differentiated strategies, there is a need for the person to apply the knowledge taught by him in his daily practice, otherwise learning is left without context (Interviewed QC).

The other interviewees had doubts about whether or not to develop differentiated teaching strategies. Some argue that different methodologies are not required. However, other professors, even though they are not from the area, believe in the need to work on strategies that stimulate students' critical thinking, regardless of the subject, according to Sleurs (2015).

Another intention of the work was to discover how the professor who works with sustainability was interested in the subject. Opinions give importance to the academy to raise awareness about the theme. Many of the professors who deal with Sustainability today were students who got to know the subject at the university and this became important to their process as a professor. It is evident, then, the strong influence of the Graduate programs for the sensitization of students to the theme of sustainability. These issues confirm the premise that universities and Business Administration courses play a key role in teaching Sustainability.

For professors who had contact with Sustainability subjects in masters and doctorates, it was asked if knowing these concepts modified their personal habits. The answers point to behavioral changes in the lives of eleven of the eighteen

professors and part of this change can be attributed to the knowledge acquired in the masters and doctorates.

Although some professors reported not being interested in the subject, when asked about the sustainable attitudes that are present in their daily routine, all were unanimous in citing examples. One of them describes the relations of Sustainability with the exclusive focus in the economic area, reflecting the line of research in which it works and probable lack of contact with the subject. Interviewee H, is related to the environmental part, with issues very related to the work that he/she performs. In this way, it can be seen that although all of them mention sustainable actions present in their life, the type of action varies according to the awareness of the theme that each one has. Note that professors who have no interest in Sustainability research have simpler examples.

It is noticed that even the professors who do not work in the area, when having contact with the subject, are sensitized and this process generates a positive impact in their lives. Many professors commented that they had no contact with the subject during their professional qualification. However, it was within the Post-graduation program, acting as a professor, through the students' demand for themes related to Sustainability, which made the professor aware. In this way, it is perceived that the process of teaching and learning is a two-way street: everyone learns at the same time, as well professors.

Another point, addressed in the interviews, are related to the main challenges to insert Sustainability in the masters in Business Administration. Six interviewees mentioned the resistance of the professors of the programs. Others believe that it concerns the insertion of the subject in the masters, how to insert and contextualize the subject in a master degree in Business Administration. The need to disclose the issue is also mentioned.

As the last question addressed in the interviews, interviewees were asked what positive aspects they identify in the Graduate Course in which they act in relation to the treatment of Sustainability. There was no unanimity in the answers. Some commented that the program is new, and therefore Sustainability is still left out, others commented that the lines of research are the positive aspect, others said they did not know the actions of the Graduation. No response is common was found among the respondents. This identifies that the management actions still can not be visualized by the professors of the mentioned masters.

4.3 Discussion

In this section, there is a discuss of the results of the interviews conducted with the professors and coordinators of the courses according to the categories of analysis proposed in the methodological procedures.

4.3.1 Knowledge Category

This category aims to analyze the level of knowledge of the interviewees according to the proposed questions. It is noticed that there is a direct relation with the area of action of the professor. The professor who works with subjects related to Sustainability, has more property in the field than the one who has already published some work on the subject and, consequently, has more knowledge than who does not minister disciplines and publishes in the area. This demonstrates the importance of insertion of thematic as obligatory and integrated disciplines in the context of other subjects.

It is also noted that the relationship between levels of knowledge does not occur at an institutional level, but at a micro level, within the lines of research and has a direct relationship with the affinities of the professor. In this way, it can be seen that knowledge about Sustainability should have more institutionalized relationships.

4.3.2 Action Category

The transposition of acquired knowledge into action was the major problem encountered in the interviews. Knowledge was perceived as a peaceful matter. Most of the interviewees knew the concepts, understood the importance, but in the moment of understanding what is the reflex of this knowledge in the attitudes, it was difficult to transpose the knowledge acquired for concrete actions. It was noticed that, in general, the actions on Sustainability exercised by the professors are usual, as separation of the trash, questions of saving electrical energy and water, as well as reuse of materials.

4.3.3 Interdisciplinary and Holistic Category

It is perceived in this category that the interdisciplinary and holistic view is stimulated by professors in general. Not specifically in the context of Sustainability, but professors in their disciplines seek to demonstrate to students the importance of understanding the context in which they are inserted, the importance of perceiving the complexity of the issues that involve the science of Business Administration.

4.3.4 Innovative Methodologies Category

In the category innovative methodologies we observed questions that also have close relation with the line of research of the professor. It was noticed that professors who have subjects related to sustainable issues affirm the need for innovative methodologies for teaching sustainability. It was observed that the relationship between theory and practice is a very important point and, even being a

master degree, there is a latent need for sustainability studies to be always worked in the context of theory and practice.

4.3.5 Management Category

In this category, two gaps can be seen within the analyzed units: the first concerns the difficulty of transposing the concepts of Sustainability of the university's higher management into the scope of course coordination. And another important aspect is that sustainability issues are not thought of at the graduate level. In this case, sustainability is related to strategies or projects of a specific line of research, which makes it less effective than if it was managed at a macro level.

5 Final Considerations

This study identifies the perceptions of the coordinators and the professors of the Graduate Studies in Business Administration regarding EpS. From the analysis of the collected data, it was perceived that the pedagogical perceptions and practices have direct relation with the professor's research line and with the type of discipline taught. Professors working on sustainability issues have more transdisciplinary and holistic views and people working on more quantitative lines are unfamiliar with the subject. Thus, it was identified the need of management policies to promote the sensitization of the professors as trainers of people.

In addition, regarding to the practices and policies of Business Administration Graduate Program related to EpS, there was an apathy of the programs in relation to the policies and strategies, and the activities that are carried out are linked to a group of professors and not to the program itself, resulting in only one program supporting such activities. It is generally perceived that there are masters with higher stages of insertion of Sustainability, and others still at the early stages of insertion.

An important contribution of the study that deserves to be analyzed is the need for máster policies to make all professors aware of sustainable issues. Sustainability can not be seen as a concept or a discipline, it must be embedded in all contexts of the university, such as in processes, management, teaching, research and extension practices.

It is also perceived that most of the actions within the programs are the responsibility of a group of professors, being institutionalized in some aspects such as: promotion of events in the area of sustainability, aid in the search for better ways of inserting sustainability within the masters, foment integration between teaching, research and extension in the programs and between undergraduate and graduate studies.

As a suggestion of new researches, it was identified the need to interview the graduates of the master degree courses, seeking to identify how the concepts were

appropriated by the alumni. Another point would be to research master degrees in other Brazilian states and, in addition, to research the programs as a whole, master and doctorate together. Finally, the limitations of the present study reside, it was not possible to interview all the post-graduate programs analyzed. In addition, the conclusions of this work represent a particular context and can not be inferred for all postgraduate studies in Business Administration.

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Part VI
Sustainable Cities and Sustainable Buildings and Sustainable Infrastructure

Promoting Sustainability: The Role of Smart Cities

Madhavi Venkatesan

Abstract The focus on progress has prompted many questions over time, namely the defining of characteristics of the attribution. Arguably, the justification of progress has been a combination of reactive explanation and focused attainment as readily observed in the case of health care and medical technologies. Analogous to the concept of progress and an example of the same is the concept of the *smart city*. Like *progress*, *smart city* does not have a universal or standard definition. However, there is agreement with respect to characteristics of smart cities; the foundational attribution is that they are sustainable. Given population demands and resource constraints, a smart city would employ available means to promote both holistic efficiency and risk management, thereby implicitly incorporating sustainability as the cultural paradigm of its inhabitants (Bishop in Ambio 22:69–73, 1993). From this perspective, though technological progress is the driver of smart city infrastructure, ultimately, it is the cultural attribution of sustainability that promotes efficiency and risk management as a norm of business as usual. Therefore, smart cities provide infrastructure to support both conscious and unconscious sustainable consumption. Coincidently, inhabitants are knowledgeable with respect to their role in promoting sustainable outcomes and police sustainability through the exercise of their consumption choices. The latter is the primary differentiator between present day economic activity and envisioned smart functioning: the conscious understanding on the part of the consumer with respect to their role as the driver of the economic model. Consumers not only have significant power to determine what and how goods and services are supplied, in their role as workers and investors, they have the ability to influence the implementation of operationalized sustainability in business. This chapter will focus on the economic elements that both promote and enable sustainability consistent with the attribution of smart city. The assessment provided differs from other research and evaluation in this area, as it does not view the standard consumer model as the basis for smart city economic development (smart economic development). Instead, the establishment of a smart city is

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assumed to be consistent with a shift in paradigm from consumerism to sustainability. As a result economic returns and growth are not the focus, quality of life parameters along with intergenerational resource allocation and ecosystem preservation are. Following a discussion of how the deployment of classical economic theory has contributed to the distancing of consumption from sustainability, this chapter will address how deployment of consumer education programs targeted to defining responsible demand, along with the market significance of coalesced demand, are a requisite foundation for smart economic development.

1 Introduction

Smart cities are fundamentally sustainable. How sustainability is reached in a city requires holistic assessment and is enabled through technology, specifically with respect to operationalizing efficiency. However, given the present consumerism fostered economy, perhaps the most significant, powerful, and traction-inducing vehicle for instituting sustainability is found in enabling conscious consumption. O'Connell (2008), views the education of the inhabitant as being the catalyst for smart city implementation and finds that education is correlated with government participation (Shapiro 2006). Government participation rates promote establishment of public goods and also ensure that social values promote self-policing of the same. Consistent with this attribution, would be that smart city planning, by definition incorporating a sustainability focused electorate, would embed government-funded infrastructure support in the form of public goods that enable sustainability in reflex activities, such as trash disposal and water use. Ultimately, through both personal decision-making and government facilitation, education promotes a self-reinforcing culture of sustainability.

2 Background Foundation of Educating for Sustainability

In the United States, consumption contributes to over 65% of gross domestic product (GDP), which since the 1940s has been the international metric for economic progress. Given this linkage and the corresponding focus on GDP growth as a proxy for progress, consumption decisions can have a significant ripple effect throughout a single economy as well as the finite global resource base. Consider for example the use of milk cartons. Wax lined, printed paper milk cartons have been created for the transport and preservation of milk from the production to the consumption stage. However, the components of the carton were not developed with waste disposal in mind, rather increasing distribution and sales were the rationale for the carton. As a result, largely related to the focused basis of its creation, the milk carton serves a consumption purpose without consideration to the impact to the environment and potential future human and animal health due to its

non-biodegradable or re-usable composition. This illustration on a broader consumption scale provides a simplified perspective to evaluate the underlying values captured in consumption decisions. From this perspective, production for consumption may be expressed as a myopic activity, focused on near-term satiation of a need or want to the exclusion of the evaluation of the impact or ripple effect of the satiation.

The values embedded and communicated within demand and supply, determine the manner in which a need or want is attained. To the extent that there is no discussion of the values and behavioral factors assumed and reflected in demand and supply, arguably, implicit values, the values and the subsequent behaviors become endogenous to the economic system. Therefore, explicit awareness of present behavioral assumptions inclusive of the "unlimited wants" of consumers, profit maximization motivations of producers, and the understated resource depletion resulting from externalized costs, offer the potential to modify active and embedded behavior.

An understanding of economics specifically oriented toward enabling the development of rational economic agent behavior, can raise awareness of the significance of consumption behavior as the activity relates to sustainability, where the defining of sustainability is consistent with the Environmental Protection Agency (EPA) (n.d.): "Sustainability creates and maintains the conditions under which humans and nature can exist in productive harmony, that permit fulfilling the social, economic and other requirements of present and future generations." Awareness in turn fosters the development and implementation of conscious and unconscious reinforcement of sustainability, which are the needed elements in driving a culture of sustainability, and in turn provides a foundational element of smart city traction and ultimately success.

2.1 Economics in Cultural Context

Economics evaluates human behavior relative to wants, needs and resource allocation within a natural environment. By definition, the parameters of the discipline include other life forms and physical resources needed to maintain both life and environmental regeneration. To the extent that a human culture incorporates non-human elements in decision-making, the economic system includes an understanding of the holistic inter-dependence of living and non-living elements of the planet.

Culture is a significant contributor to what is perceived as valuable and is the determining parameter in the designations that ultimately yield to resource allocation within a society. Given that culture is a learned behavior, culture can either promote or diminish any given society's understanding of the interconnectedness of human and planetary life, thereby determining the extent of the anthropocentric, or human-centered, perspective. The United Nations Educational, Scientific and

Cultural Organization, UNESCO, defined culture as a significant component to attaining global sustainability:

> Culture shapes the way we see the world. It therefore has the capacity to bring about the change of attitudes needed to ensure peace and sustainable development which, we know, form the only possible way forward for life on planet Earth. Today, that goal is still a long way off. A global crisis faces humanity at the dawn of the 21st century, marked by increasing poverty in our asymmetrical world, environmental degradation and shortsightedness in policy-making. Culture is a crucial key to solving this crisis (UNESCO 2000).

The inputs and outputs of economic systems are dependent on the value structures of a society and to the extent that economics explains observable phenomenon and proposes optimal outcomes, the discipline can be both responsible for the maintenance of an economic framework and also the catalyst for a change. Economic outcomes in essence mimic the values of the participants in an economic system.

Evaluating the historical cultural progression of human society can promote a stronger understanding of the economic relationship with resource allocation, both intra- and inter- society, and most importantly provide insights with respect to how perceptions of the world are shaped through cultural frameworks at a given point in time. The pace at which cultural attributes evolve may also provide a deeper understanding of why institutional and social frameworks may be inconsistent with the manifestation of contemporary challenges. Viewing economic thought or philosophy over time reveals the dynamic and cultural elements of society, as well as the basis of economic thought that remains in the principles literature in the present period.

2.2 Reconciling Economic Theory and Historical Context

The cultural attribution of value is a significant and arguably primary differentiator with respect to the variation in the perspective between societies of the quality of life for both human and non-human elements. Examples of surviving written works that provide a foundation or insight with respect to economic activities include Plato's *Republic* and Aristotle's *Politics*. The similarities in economic circumstances as described by the authors are consistent with the phenomenon observable today; however, the evaluation of human behavior as it applied to accumulation of wealth, stratification of society, and the role and impact of gratification were framed within an evaluation and discussion of moral philosophy and ethics, positioning Western economics up to the eighteenth century within the discipline of moral philosophy and politics. The evolution of the discipline continued through the modern era until the discipline formerly separated from moral and political philosophy through iteration as political economy to its present standalone context as economics. The observable mechanics of economic systems were the basis of discussion in conjunction with the human values, whether assumed as innate or

culturally inspired. A connection between the qualitative and quantitative aspects of economic outcomes was articulated and addressed as an evolving and dynamic process. From this perspective economics discussions offered both a *normative* and a *positive* perspective, where the former provided opinions and values related to optimization and the latter described observable activity. At the present time, the economics in practice has shed the normative element of the discipline opting for a positive attribution as a means to enhance its standing as a science. In essence the focus on optimization has been to the exclusion of explicit evaluation of prevailing values. Given the significance of embedded values in conscious decision making, the lack of articulation of values may contribute to the implicit value of outcome based decision-making that only considers the optimization of the outcome rather than the impact of the outcome to others and future consumption. Perhaps the modification of the defining of the boundaries of present economic thought to be independent of a value-based foundation may in part provide an explanation for the imbalance in sustainable outcome observable today yet credited as being attributable to economic optimization.

The foundation for current economic thought can be found in the writings of Adam Smith, Jeremy Bentham (1879), David Ricardo (1911) and Karl Marx (1968) along with many others. However, though all of these authors provided insights related to the human behavior attribution of economics contemporary to their time and though the circumstances described appear contemporary, the context of their writings has often been neglected in lieu of an adoption of an absolute meaning of their opinions. In essence, allowing the commentaries of these authors to embody a universal significance independent of time has arguably enabled the transfer of the theoretical modeling of a society specific to one period to another, independent of the observable change in society.

2.3 *Significance of Context*

The Classical period of economics has become the foundation of the study of the discipline of economics. To a large extent, the economic principles in practice have maintained the theories espoused by the writers and contributors to economic thought contemporary to the period. John Stuart Mill's *Principles of Political Economy* (2016) provided a summary of the contributions to economic thought by Adam Smith, David Ricardo and other significant thought leaders of the nineteenth century and became a standard text used in the study of economics into the early twentieth century. However, of note is that the authors including Mill were relaying behaviors perceived in a society contemporary to their life and questioning aspects of the observed progress of the time including poverty, the role of money and the potential impact of population growth. Their thoughts were debated discussions and their frameworks were not adopted as immutable facts. Additionally, the issues discussed were similar to those of predecessor Western societies and as evidenced in the moral philosophical discourses of Plato and Aristotle, nearly two millennia earlier.

Of significance in the noted persistence of specific economic system fostered social outcomes are the cultural and time specificity of observed similarities. The evaluation of the human condition within a given social and economic framework provides the challenge of economists to both be positive evaluators from the perspective that positive signifies reporting on observable and factual phenomenon and normative participants, where normative requires an expression of value judgment.

Present instruction of economics has eliminated the normative aspects of assessment, reducing economics to mathematical relationships that are addressed in absolute terms rather than in alignment with cultural attributions coincident with their development. Further the seeming lack of attention to values and behavior incorporated within economic assessment has distanced the tangibility of economics, limiting understanding of the explanatory potential of economics and the application of economics as both a cause and a remedy of unsustainable practices (Dillard 1982). There is a need to promote and foster an understanding of the role of values in economic outcomes and the sustainability of observed outcomes. In enabling this education, consumers cannot only understand the intergenerational impact of their actions, they can appreciate and support the requisite sustainability infrastructure and regulations of the smart city.

3 Perception of Resource Value, Market Outcomes and Price

Economics is the social science discipline that evaluates the relationship between human wants and the resources available to satisfy them. In identifying and explaining the relationship between wants and resources, economists use broad generalizations related to human behavior, arguably the most significant of which relates to wants.

Wants are based on the premise that individual economic agents, individuals interacting within the general economy, will always seek to have more of desirable goods and services. Desirable goods include both normal goods, which are goods that an individual will continue to purchase as their income increases and luxury goods, which are goods that are not needed but are wanted to support an external display or perception of status or wealth. Not all goods are desirable, for example, inferior goods represent a classification of goods and services that will be reduced or eliminated by consumers as their incomes increase.

The behavior of wanting more, sometimes referenced as unlimited wants, is a social value, consistent with consumerism, which is defined as the focused act of consuming goods and services to improve utility, the economic concept that defines the benefit of consumption. Arguably it is not representative of an intrinsic human characteristic but rather a learned behavior. This is an important point. If a behavior

is learned it can be unlearned and a new behavior can emerge, which in turn can produce a different economic outcome.

Resources are broadly defined as including all the inputs in the production of final goods and services that are ultimately tied to the satisfaction of a want. From this perspective, resources could include teak wood trees in the making of furniture; water in the production of soda; and cattle in the production of food. Typically, resources are classified into one of three groupings, which include: natural resources, human resources, and capital resources. Trees, water, and cattle are all natural resources. Human labor or entrepreneurship define human resources and capital resources consist of man-made objects that can be used to produce goods and services, such as factories and equipment. Regardless of the type of resource, all resources are finite and so by definition can be qualified as scarce.

Scarcity in economics essentially captures the relationship between wants and the access and availability of resources. For example, one could want a mango, see it hanging high on a tree but not have a ladder to reach it. The good in question is available but it is not accessible. Alternatively, one could stumble on a farmer's market selling mangos only to find that all the mangos on display have been purchased. In this case the mangos are accessible but they are not available. Both of these examples highlight the temporal or time sensitivity of scarcity. In the first example, one could borrow or purchase a ladder but this will take time and in the second scenario, one can drive or walk to another market, but again, additional time will be required to satisfy the want.

Looking at time in a slightly different manner, a community could require lumber for the construction of new municipal buildings. The lumber required will result in the deforestation of one hundred acres. In satisfying the want for lumber today, the community limits access and availability of lumber from the one hundred acres over the time period required for the forest to regenerate, creating time based scarcity.

In a market system, access and availability establishes a perceived scarcity embedded within the supply of a good. Ultimately, the supplier's willingness and ability to sell a specified amount of a good at a prevailing price is assumed to capture the costs of production of the good, implicitly including the scarcity of inputs. As a result it is expected that the higher the degree of perceived scarcity of a resource, the higher its price and in the case of an input, the resulting price of the final good.

3.1 Market Distortions

Market outcomes, price and quantity, are highly dependent on the information that consumers and suppliers have available. Informational asymmetry, where one party has more understanding or knowledge related to a good than another, can create price and quantity outcomes that may not effectively consider scarcity. This results in market inefficiency, a situation where resource use is not efficiently allocated by

the market. This is a significant issue and one that consumers are only beginning to understand. For example, abundance is a relative term but it is not inconsistent with scarcity; all resources are scarce. The perception of abundance without the recognition of inherent scarcity of resources can hasten resource depletion.

The production of goods by producers is based on a competitive framework. Additionally, the producer seeks to minimize costs and maximize revenue, to achieve maximum profitability. As a result of the focus on profitability, there is significant incentive for producers to externalize costs of production as a means of cost minimization. Externalizing costs can include pollution discharge, exploitation of regulatory differences between countries, overuse of natural resources, and limited waste disposal and reduction efficiencies. Though in the immediate period this may be beneficial to profitability, it may promote both short-lived unsustainable returns and longer-term environmental and social costs (Choi and Ng 2011; O'Hara 1995).

Consumers may not be aware of the implicit tradeoffs being made as a result of the production of a good. This informational asymmetry can be attributable to many reasons, including a belief that regulatory agencies guarantee safety, to just simply a lack of diligence when assessing goods. For consumers, reliance on market efficiency without an understanding of the embedded incentives of producers can promote negative externalities. In effect the pursuit of satisfying unlimited wants may include effectively delegating environmental and social stewardship to producers whose incentives may not include the evaluation of these parameters. The end result is most readily seen in natural resources, where under pricing due to lack of inclusion of scarcity can lead to extinction or elimination of a resource's availability.

In a market driven economy, such as the U.S., the market is credited with efficiently determining the price of an item by implicitly incorporating the costs associated with production. When consumers or producers face low prices for consumption and input purchases, respectively, and the underlying belief is that the price being paid is fully reflective of the cost of the item being purchased, there is less of an incentive for efficient use and higher potential for waste. Price is effectively becomes a measure of a resource's worth. When asymmetric or incomplete assessment of scarcity is prevalent, price may not properly indicate the cost of the resource being consumed.

In some areas of the world, forested land has been perceived as abundant and the resulting price for land has been limited to the perception of present period abundance. The net result of the perception has been excessive global deforestation, resulting in present period-pronounced scarcity in some regions. Decades will be required to promote regrowth of the same lands. Had prices considered the impact of forest harvesting, or the price of temporal scarcity, demand would have been lessened. Both consumption and production could have promoted efficient market pricing leading to sustainable resource use, all from this simple inclusion.

3.2 Externalities

Demand and supply yield market outcomes that are assumed to represent an efficient allocation of resources. The price at which the quantity demanded equals the quantity supplied is therefore expected to embody the cost associated with the production and consumption of the good or service. However, production and consumption are not limited to the transactional nature of exchange of the final good at the determined market price. In the process of production and consumption there are costs that are not factored which impact the well being of the economy at large and these are referenced as externalities. In essence, externalities arise when an individual or firm engages in activities that influence the well being of others and where no compensation in provided in exchange for the imposition.

Typically externalities are characterized as negative, signifying that the externality yields an adverse outcome. These externalities are referenced as being *negative externalities*. However, there is a potential that a positive outcome could be generated leading to a positive externality. In the discussion of externalities it often assumed that market participants accept the externalities generated b their actions as acceptable due to their focus on immediate gratification of their needs. For the producer this equates to externalizing the cost of disposal of waste products into waterways and the air where no cost is directly borne to adversely impact profits but qualitative costs are assessed that may impact the enjoyment and longevity of multiple life forms and generations of human life. For the consumer the externality can be evaluated in the indifference to waste creation at the point of the consumption decision or even the externalities associated with the production of the good or service being purchased. In the case of the former, the cost of disposal of packaging material is typically marginal to zero, relatively negligible, but disposal creates a negative externality in the landfill, incinerator or recycling plant that could have been avoided with a thoughtful exercise of demand.

At present, the type of internalizing of externalities that has occurred has been limited to quantifying the externality to an overt cost. However, to the extent that the costs may remain unassessed and the market mechanism is not cognizant and focused on the elimination of the externality-based cost, rather the minimization of overall costs, this process has yielded suboptimal outcomes (Boran 2006; Czech 2000). For example, assume that a firm produces ambient pollution as a result of incineration of waste. If a governmental regulatory body institutes a fee or cost for pollution, effectively charging the firm for the ability to pollute the air, the producer is able to delegate responsibility for environmental stewardship to the price of pollution. Additionally, depending on the price elasticity of demand for the service offered, the producer may be able to not only transfer the costs now associated with polluting activity to the consumer, but may also be able maintain the pollution level. Assuming that the consumer is inelastic, in this example the negative externality related to internalizing the cost has not changed, instead only the responsibility of pollution has been transferred to a cost, revenue to the regulating body has been

generated, and the consumer has suffered erosion in their overall disposable income and purchasing power.

The same type of scenario exists with a permit trading program, where in effect permits are issued for a specific amount of externality emission, allowing economic agents to trade and thereby optimize through again cost minimization. However, the cost minimization is founded on the presumption or delegation of the permit system to fostering socially optimal outcomes, again, relieving the economic agent engaged in the creation of the externality form being directly accountable for qualitative actions. Additionally, the trading of permits assumes that optimal financial outcomes equate to optimal environmental and social outcome due to the aggregated assessment of pollution. However, to the extent that pollution is not distributed evenly and certain locations may have a disproportionate concentration, the permit systems fails to generate a socially optimal outcome. This may be compounded by the impact of inelasticity, which may allow for the transfer of costs of implementation of the permit program to the economic agents the program was designed to protect.

Externalities are defined as a type of market failure based on the premise that optimal social outcomes result from individual economic agents acting in self-interest. However, if instead of being a market failure, externalities could be evaluated to assess and develop an optimizing strategy between individual interests and enhanced social outcomes, externalities could be internalized within the market model as a modification of preference. Perhaps externalities only indicate a lack of holistic awareness on the part of the consumer and producer or a cultural bias toward immediate gratification. These characteristics can be potentially modified through education. Optimal and universally acceptable strategies could then be adopted to promote sustainability.

The success of this internalization strategy relies on the development of the educated rational economic agent as a consumer. If consumers are aware of the responsibility inherent in their consumption and are aware of the environmental and social impact of production processes, consumer demand can create the coalescing framework to augment preference to exhibit demand for sustainably produced products. The augmentation in demand does not allow for the opportunity of delegation of responsibility of pollution capacity to a cost or alternatively, the incorporation within a cost minimization framework, as a result, the change in preference and subsequent modification in demand promotes the development of market outcomes that are environmentally and socially optimal from the position of what is supplied. Smart cities inherently require consumer cognizance to promote dynamic continuous improvement consistent with the maintenance of long-term sustainability. However, the focus of the smart city also requires educated consumer inhabitants to ensure the provision of both public and common goods as provided through environmental and government regulation and oversight.

3.3 Common Goods

Resources such as air and water have no market price and are considered to be abundant. On the surface, these resources may appear to be unlimited however, increased population pressures along with externalized costs related to production, such as pollution, have diminished the availability of both potable water and clean air. How could this have occurred?

The lack of price, a market model promoting the focus of profit maximization and unlimited wants are largely responsible. Consumers have effectively allowed supply to determine demand by not imposing restrictions on how goods can be produced. Producers have focused on short-term profitability in lieu of long-term strategic resource utilization. In the short-run both consumers and producers have benefitted but the cost of consumption and profitability was externalized to other nations, the environment, and future generations. For example, in the seventeenth century, North American coastal waters were described and recorded as being rich in quantity and diversity of fish; the perception of abundance led over time to overfishing and presently many varieties are endangered or at the risk of extinction. The cost of fishing included the human and capital costs not the replenishment costs. This yielded an ability to maintain artificially low prices, greater yields for profitability (over fishing), and waste.

3.4 Market Prices

An understanding of the perception of scarcity and abundance provides a strong foundation to understanding supply, demand, and market outcomes as these concepts relate to resource allocation and sustainability. To the extent that consumers delegate responsibility for sustainable consumption to producers and producers are focused solely on profit maximization increased understanding of the responsibility inherent in consumption may provide a catalyst for increasing sustainable production, consumption and development. As holistic evaluation of consumption is an assumed behavior of the rational economic agent, strengthening the understanding of the role of consumption may be significant in enabling the development of the rational economic agent.

Supply and demand reflect the amount that producers or suppliers of a good or service are willing and able to sell at a particular price and the amount that consumers of a good or service are willing and able to purchase at a particular price, respectively. Though on the surface the concepts of supply and demand appear simple the characteristics that determine the explicit willingness and ability can be complex. The complications can arise as a result of differences in the preferences, behaviors, cultural values, financial capacity, as well as resource access and availability to the production process as these relate to suppliers. For consumers or demand, the complications can also be attributed to preferences, behaviors, cultural

values, financial capacity and wealth perception, as well as the perception of value and price, along with access and availability, of other substitute and complementary goods. Where and how the supply and demand interact with each other define a market. A market is comprised of a group of producers (supply) and consumers (demand) for a specific good or service, who collectively, as part of their exchange process, determine the market price or equilibrium price of a good or service.

Price is the natural outcome of the supply and demand relationship. It is indicative of the value of a good based on a consumer's assessment of the costs and benefits of purchasing the good. As consumers become increasingly aware of the environmental and social costs of production, the prevailing price may be corrected either through regulatory imposition of the costs of externalities within the market mechanism or via consumers, who will opt to purchase goods not on price but related to holistic production costs.

It is important to note that the market relationship is dependent on information and understanding of the limits of duty of care. The outcome of the market relationship, price and quantity, can only reflect the embedded preferences and social values depicted in demand and supply. If the market outcome does not meet expectations, the market model is not to blame; rather the prevailing value structure may be the flaw.

Value in this context is related to how resources are valued from the perspective of the quality of care and maintenance we would be willing and able to provide to ensure the protection of the resource. The use of the word "value" is not directly based on market quantification but expresses the hierarchical importance that consumers and producers would attribute to a resource; examples may include the environment, human health, and animal welfare.

Every day consumers make decisions with the collective strength of aggregated individual demand. These decisions influence supply and demand going forward, including the ability of producers to develop new goods and services, as well as resources and technological advances to satisfy both existing demand and projected future demand. Demand is a powerful catalyst in the evolution of market outcomes. However, to a large extent the power of demand is limited both by the fragmentation of consumers due to limited opportunities for coalescing around specific interests and limited consumer understanding of the inherent power of aggregated consumption decisions. From this perspective, understanding how the market functions and the power of consumption in creating sustainable economic outcomes is one aspect of developing into a rational agent.

The values embedded and communicated within demand and supply, determine the manner in which a need or want is attained. To the extent that there is no discussion of the values and behavioral factors assumed and reflected in demand and supply, arguably, implicit values, the values and the subsequent behaviors become endogenous to the economic system. From this perspective, explicit awareness of present behavioral assumptions inclusive of the "unlimited wants" of consumers, profit maximization motivations of producers, and the understated resource depletion resulting from externalized costs, offer the potential to modify active and embedded behavior (Shah 1999).

4 Conscious Consumption and the Sustainability Foundation of Smart Cities

The explicit discussion of the embedded assumptions guiding the behavior of the decision-maker is typically not a part of the economic education process (Junyent and Geli de Ciurana 2008). As a result, to the extent that individual economic agents, producers or consumers of a good or service, are bounded by rationality that does not include addressing the impact of externalized or non-quantified costs, the economic discussion does not promote or position the assessment of alternative outcomes. Implicitly and endogenously, the economic discussion establishes and maintains a consumption to production circular flow, focusing on the gratification of consumption and profit taking from production, seemingly eliminating assessment of externalities and holistic dynamics. Returning to the milk carton example provided in the **Introduction**, the economic discussion would be limited to the utility gained from consuming the milk and the corresponding profit maximization of the producer. Waste would be regarded as an externality rather than an endogenous aspect of the decision making process. Additionally, costs are priced into the product through efficient market assumptions. In net consumers would expect that the purchase price is indicative of the holistic cost of the product and producers would view production costs as being related to market priced inputs not environmental impacts during or as part of the life cycle of the good.

As Nelson (1995) points out, economics evaluates efficiency with respect to the "use of resources to maximize production and consumption, not by the moral desirability of the physical methods and social institutions used to achieve this end." The factors that are included in an economic evaluation are limited to the tangible quantifiable costs and costs are overlooked where either a market or regulatory oversight has not provided a monetary justification. From this perspective, the impact of consumption decisions on the environment, economic disparity, or endangerment of other species is not an issue. The market mechanism disenfranchises the consumer from the welfare of those impacted by his/her consumption and promotes the perception that price alone is indicative of the true cost of a good. Nelson notes, "The possibility that consumption should be reduced because the act of consumption is not good for the soul, or is not what actually makes people happy, has no place within the economic value system." The underlying assumption is that consumers are driven to want more. As a result, economic modeling assumes that reduction in consumption in the current period is only addressed through the lens of an increase in consumption in a later period. That the assumption of insatiable want may be taught a learned behavior, reinforced through a market model is not even addressed in economics (Colander 2005; Knoedler and Underwood 2003).

A general and seemingly applicable assumption is that consumers and producers maximize the benefit related to the opportunity accessible in their particular circumstance. The desire to reach an optimal outcome for a given point in time, as has been noted before, is subjective and specific to how these economic agents view the concept of maximization, which in turn is likely to be highly correlated with

cultural values. For example, in Indigenous societies there is evidence that a balance between present and future periods along with that of the environmental system, as a whole, was included in decision-making and optimization. In present consumerism fostered economies, the cultural values are less likely or unlikely to incorporate environmental and social justice parameters proactively. The focus of observable and marketed consumption is immediate gratification. However, as consumer awareness of both the impact of consumption and the power of consumption to modify and catalyze economic outcomes increases there is growing evidence of a shifting cultural paradigm to one of sustainability.

Markets do fail to produce optimal outcomes. Sometimes this is due to the myopic focus of market participants as in the case of externalities and in other circumstances it can be attributable to the lack of excludability as in the case of common goods. To some extent cultural values dictate the significance of the adversity related to the creation of externalities or abuse of common goods. The use of market models has been the regulatory mechanism to modify socially non-optimal outcomes, but through relying on the market mechanism rather than simultaneously including mechanics to promote cultural change, the majority of regulatory interventions to date have had limited to questionable success.

4.1 Smart Economic Development

The present global status of recognized environmental degradation, exploitation and resource depletion tied to understating of holistic of costs and ultimately the pursuit of a narrowly defined consumption-based metric of economic progress, gross domestic product, has promoted an increased multidisciplinary interest in sustainability. By definition the concept of sustainability incorporates the intertemporal allocation of resources through a holistically assessed strategic utilization rate that includes environmental and social justice parameters. From the Brundtland Report:

> Sustainable development is development that meets the needs of the present without compromising the ability of future generations to meet their own needs. It contains within it two key 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.

The defining of sustainability is in close alignment with the objective of the discipline of economics. From the Introduction, "Economics is the study of human behavior in relation to a resource-constrained world." The ability of economics to add value to sustainability objectives requires the insertion of value parameters or normative thinking in conjunction with the positive or observational stance adopted by the discipline. The catalyst for the value based practice of economics rests with the ability to promote an understanding of the discipline, establish pervasive

rational agent behavior in the economy and promote attainment of optimal social and environmental outcomes rather than observationally recording the realization of the theory of second best. The latter is embedded in the characterization of market failure and externalities. Establishment of rational agent decision-making and thereby responsible conscious consumption provides the conduit for paradigm shifting from consumerism to sustainability.

A constituency with an understanding of the holistic relationship between consumption and sustainability and having engagement in government (O'Connell 2008), are foundational elements in the social policing and infrastructure of smart economic development. This chapter prompts further evaluation in the mechanics of sustainability focused education and also establishes the view that the measurement of success of smart economic development may not be captured in present, standardly used metrics, namely GDP, given that the underlying values that support GDP expansion may be inconsistent with the success parameters associated with sustainability.

4.2 Next Steps Theory and Practice

Smart cities are sustainable. The defining of sustainability is in close alignment with the objective of the discipline of economics. The ability of economics to add value to sustainability objectives requires the insertion of value parameters or normative thinking in conjunction with the positive or observational stance adopted by the discipline (Venkatesan 2016). In comparing economic frameworks, Sustainable Economics due to its acceptance of the breadth of human attribution is well positioned to both assess and thereby through evaluation, promote iterative policy implementation to support the inclusion of the paradigm of sustainability as a societal norm.

Rational Economics suggests market instruments, while Sustainable Economics suggest a policy mix. The kind of government programs that are recommended depends on the impact of consumption determinants. For instance, if rational and economic determinants have a great impact on consumer behavior for a certain product, market solutions might fit best and be combined with educational (indirect) instruments. In contrast, if economic determinants have a low impact and if involvement is low, direct instruments should be put in place. So in general, before implementing government programs it should be investigated which factors influence consumption and this should include education. This could be done by a mixed methods approach including multivariate data analysis. For this reason, much more research on the specific effects of the government programs and the effects of their combination is necessary.

Further, there is a necessity to operationalize the concept of sustainability and introduce new measuring systems beyond the GDP. Evaluation of the sustainable development of a society and the impact of government policies through the lens of GDP is not sufficient. On the contrary, a focus on the GDP is consistent with the

promotion of consumerism, which in turn is congruous with resource depletion and externalizing costs. Smart cities will have to be assessed based on non-traditional economic factors, if the objectives of their implementation are to be realized.

5 Final Thoughts

Smart economic development is dependent upon holistic and routine evaluation of economic and societal frameworks. These frameworks need to be assessed and modified as part of an on-going continuous improvement process. Fundamentally, what may have been viewed as appropriate action at a point in time may no longer serve the same purpose due to changing environmental, social and cultural parameters. However, the members of a society have to be both empowered and cognizant of the need for this type of evaluation in order for efficiency and ultimately sustainability to be a realized inter- and intra- generational attribute. From this perspective, the deployment of consumer education programs targeted at defining responsible demand, conscious consumption, are a requisite foundation for smart economic development (Wetzel et al. 1982).

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How Technologies Contribute to Urban Sustainability: The Case of Curitiba—Brazil

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Abstract New research are being developed continuously seeking for technologies that improve life quality. Among the topics addressed in these studies, the development of technologies for the urban environment with a focus on sustainability presents itself as a relevant theme. Since the 1970s, concepts of intelligent cities have been discussed, highlighting strategies focused on physical, social, institutional and economic infrastructure in an innovative and sustainable way. This work aims to analyze the city of Curitiba, capital of the state of Paraná (Brazil), considered a model of an intelligent Brazilian city. The method used was the case study, focusing on strategies applied in the abovementioned city. A documentary review was also carried out based on the UN Habitat III discussions held in Quito (Ecuador), on sustainable urban development studies for the new agenda of 2030. Results show that Curitiba stands out mainly for its mobility, economic development and urban innovations, and demonstrate that technology helps to promote transparency and greater efficiency in services provision, mitigating resources use inefficiency and contributing to the environment and its population life quality.

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Finally, in the final considerations, it is stated that conscious addition of new technologies tends to increase efficiency of cities and contribute to a balanced development in the economic, social and environmental sectors.

Keywords Smart cities · Sustainability · Curitiba · Technology
UN- Habitat III

1 Introduction

Nowadays, facing rapid urban population growth and new demands of the 21st century, the need for innovations in cities, whether through infrastructure, services or issues related to management and economy, is undeniable, as it is estimated that in 2050 the world's urban population will reach 66%, or 2.5 billion people living in cities (United Nations 2014). Transformations resulting from accelerated growth generate a series of challenges for cities, since basic functionalities end up becoming difficult, such as waste management, issues related to health and public safety network, mobility, among others (Batagan 2011).

From this reality, it is extremely relevant to study and plan cities. Thus, based in this scenario, concepts such as "smart cities" or "global cities" emerge, that mostly aim at a planet with greater balance. In order to reach this goal, cities need to reinvent themselves and adapt into a more intelligent and sustainable way, that is, they need approaches that foster new knowledge and tools that promote urban planning and design to meet the needs and challenges of contemporary urbanization, using technology as an ally in order to manage information and to become a connected and intelligent system (UN Habitat 2012).

Kanter and Litow (2009) affirm that smart cities are those capable of connecting infrastructures and information and communication technologies (ICTs) in an innovative and efficient way, in order to increase the urban sustainability and quality of life of the population. For Toppeta (2010), the cities known as smart are those capable of uniting the benefits offered by ICTs and the Web, allied to organizational and planning efforts, in order to speed up bureaucratic processes, identify problems and solutions, improving cities overall management. In this way, ICTs play an important role and act as facilitators in decision-making, as well as improving issues related to services and infrastructures monitoring and management, facilitating city management and guaranteeing enhanced quality of life for city residents (Meier et al. 2011).

The Habitat III Conference promoted by the United Nations in Quito (Ecuador) in 2016 on sustainable urban development studies for 2030 agenda also generated reports qualifying ICTs. It was highlighted that they enable digital platforms that support information and knowledge networks creation that allow aggregation of information and data not only for analysis but also intensify the understanding of how cities work and help in the design of public policies and in decision-making processes (UN- Habitat III 2015e). Facing this new scenario of innovation and technology, some questions arise: how have Brazilian cities been facing this new

reality? How are technologies inserted in their management and how do these bring benefits for managers and population?

In order to answer these questions, in 2015 a project mapped the cities with the greatest potential for development in Brazil, based on indicators of intelligence, connection and sustainability in 11 sectors: security, economy, energy, governance, entrepreneurship, mobility, health, education, environment, technology and urbanism. This work originated the Connected Smart Cities Ranking, which evaluated and classified 700 Brazilian municipalities according to their development level (Connected Smart Cities 2016). Curitiba, capital of the state of Paraná (Brazil), ranked 3rd in the overall ranking, especially standing out in the sectors of environment, education and governance (Connected Smart Cities 2016). In addition, in 2010 Curitiba ranked 3rd among the most intelligent cities in the world, according to Forbes Magazine. In 2012, the city ranked 1st in the ranking of digital cities in Brazil according to the National Council for Scientific and Technological Development (CNPq) and at the UN Habitat III Conference the city was cited several times as a model of intelligent management.

Therefore, this study aims to explore a real case of a Brazilian city considered intelligent and sustainable, the city of Curitiba. The goal is to investigate what differentiate this municipality from others, as well as to identify benefits generated for both the city and the inhabitants, taking into account that these improvements come from a constant evolution and that these practices are not of instant applicability. Data collected of the city of Curitiba were compared and complemented by the debates and studies carried out by the UN in Quito (Ecuador) at Habitat III—3rd World Conference on Housing and Sustainable Urban Development, in which presented Curitiba as an example of a resilient and sustainable city.

This study is justified due to the importance of thinking about Brazilian and around the world cities improvements regarding new technologies and innovations. Furthermore, debate possible understandings through UN studies and findings of the international scenario and the advances, new possibilities and challenges for urban areas. In the next topic, a literature review of the aspects to be analyzed in the city of Curitiba will be presented.

2 Literature Review

Leite and Awad (2012) state that "cities are the greatest artifact ever created by man" and due to the great opportunities they offer, they become increasingly more attractive. However, it is well known that rapid urbanization poses increasing challenges for cities and, in this context, governments, companies and academia must think together for innovative and urgent solutions (UN-Habitat 2012).

In response to increasing demands in urban areas, main global providers of technology have made an effort to improve conditions and functionalities of urban spaces and infrastructures, focusing on information and communication technologies, making undeniable their need in cities management (Weiss et al. 2013).

There are a number of possible applications for ICTs such as: wireless sensor networks, smart grids, mobile devices, geographic information system-GIS, cloud computing, etc. Thus, ICTs in smart cities have a prominent role from data collection to decision making (Gama et al. 2012).

In addition, Chourabi et al. (2012) state that cities must have an efficient combination of digital telecommunication networks, which work as the cities nerves; ubiquitous intelligence, functioning as the brain of the city; sensors and tags, which are the sensorial organs; and finally, softwares, which function as the cognitive competence of the city.

Thus, turning a city into an intelligent city is not a revolution but a necessary evolution for the cities development, oriented in harmonizing the material and virtual world. In order to create an intelligent city, technologies must connect different systems, acting as facilitators, in which people increasingly have online access to all urban services, as well as assisting the city knowledge itself, contributing to the creation of more efficient projects through monitoring and more efficient management (Toppeta 2010).

It should be emphasized that an intelligent city cannot be understood solely as that supported by technology. An intelligent city goes far beyond that, that is, it is capable of solving fundamental questions such as housing, health and public safety, mobility, public spaces among others, in order to provide life quality for all its population. In this way, technologies can help in these aspects, but it is not necessary that the city be fully computerized so that it is considered intelligent, but that there is an efficient planning and management together with long-term development strategies. In addition, smart cities are those that have intelligent citizens, so a participatory and collaborative planning is also part of this concept, that is, decentralization in decision making and adoption of improvements from small initiatives should be part of an intelligent city (Getúlio Vargas Foundation 2015). Below, a brief literature review of the points to be analyzed in the city of Curitiba will be presented.

3 New Technologies and Urban Sustainability

According to IBM (International Business Machines), smart city is defined as the use of information and communication technology to sense, analyze and integrate key information of core running cities (Su et al. 2011). In short, promoting and applying technological innovation should be the focus of cities for the coming centuries as it has become a key factor to solve emerging challenges such as water scarcity, reuse and waste recycling, sustainable mobility and climate change. According to the UN-Habitat (2015e), modelling may be a parameter for contemporary cities that seek to become more intelligent and achieve urban sustainability, relying on information and communication technologies.

Taking this into account, it is understood that ICT has great potential for a sustainable and intelligent development of cities. They can be applied in several

sectors and tend to increase control and efficiency in services offered, citizen participation in decision making, accessibility and security of public spaces, and mitigate negative impacts from disasters.

Therefore, it is well known that cities need to develop in a sustainable way and manage their changes in current development models, not only to reduce environmental damage from dense urban occupation, but also to guarantee quality of life for the population. It should be noted that as investments in technological infrastructure increase, efficiency in the provision of resources and services increases, creating a more sustainable city (Fiorentino et al. 2012). Thus, minimizing resource extraction, energy consumption and waste generation, while safeguarding ecosystem services, is essential for a sustainable urban development. "Untying resource use from environmental impacts and economic growth contributes to sustainable development and poverty eradication" (UN- Habitat III 2015b, p. 9).

Nevertheless, for a city to make efficient use of available resources, it must combine productivity and innovation with lower costs and reduced environmental impact. Intelligent and sustainable cities need to be planned, designed, implemented and effectively managed, with well defined goals, political cohesion, control and transparency towards society (UN- Habitat III 2015e).

It should be noted that the process of transforming a city into more sustainable and intelligent is complex and there are many paths to follow. There are long and short term objectives and must be studied and adapted to the reality of each locality. Leite and Awad (2012) point out that within cities are found the challenges of the 21st century, but the possibilities and solutions are also found within them. Cities are responsible for promoting improvements and strengthening their effectiveness.

4 Transport and Mobility

Smart city is intended to deal with the problems generated by rapid urbanization and population growth, such as energy supply, waste management, and transport (mobility), through higher efficiency and resource optimization (Calvillo et al. 2016).

For the UN, sustainable mobility and transport must be accessible to all, since:

> The goal of the entire transportation system is to create universal access to safe, clean and affordable transportation for all, which can thus provide access to opportunities, services, goods and equipment. Accessibility and sustainable mobility is mainly related to the quality and efficiency of arriving at destinations whose distances are reduced through efficient transport equipment and infrastructures. Thus, sustainable urban mobility is determined by the degree to which the city as a whole is accessible to all residents, including the poor, elderly, young, disabled, women and children. (UN Habitat III 2015d, p. 1).

The transport sector is a significant energy consumer and one of the main sources of air emissions within cities, generating important health related issues (Villar et al. 2013). Furthermore, quality of transport systems directly affects quality of life for city inhabitants. Thus, transport systems should be planned to be cleaner and more efficient.

5 Green Areas and Public Spaces

Green areas play an important role for the urban environment as they provide moderation of urban microclimate, air quality improvement, opportunities for recreation and citizens' health improvement (UN- Habitat III 2015b). Nature in the urban environment produces services that not only provide benefits for human well-being but are necessary for maintaining ecosystems themselves. These natural elements contribute directly to public health and increase quality of life of urban residents (Chaparro and Terradas 2009).

At the 23rd session of the UN-Habitat Governing Council in 2011, member states delegated UN-Habitat to consolidate the work on public spaces, develop and promote policies, disseminate knowledge and assist cities in initiatives aimed at public spaces. The UN Open Working Group on Sustainable Development Goals 2016–2030 proposed a goal, which aims "to ensure universal access to safe, inclusive and accessible public and green spaces by 2030" (UN- Habitat III 2015a, pp. 1–2).

In addition, the presence of large green public spaces generates fairness, that is, where public space is inadequate, poorly conceived or privatized, the city becomes more and more segregated. Well planned and accessible public spaces highlight issues related to people's rights, such as freedom of expression, political assembly and civic empowerment, allowing the population to enjoy these spaces, integrate the city itself and have the opportunity to make exchanges between citizens, reducing crime and violence (UN- Habitat III 2015a).

6 Waste Management

Regarding waste management, Habitat III Thematic Document on Urban Infrastructure and Basic Services, including energy (2015c), states that:

> The growing demand for urban infrastructure was not accompanied by a proportional increase in the financial and institutional capacity needed to manage urban infrastructure services. For example, revenue generation for services such as solid waste, water and electricity management typically does not cover the cost of providing these services. Thus, there is a need for more innovative and inclusive business models, especially models that can more effectively gather resources for investment that may involve the private sector and community groups in financing and managing services. (UN- Habitat III 2015c, p. 4).

Generally speaking, cities generate more than 2 billion tons of urban waste and this number is expected to double over the next 15 years (UN-Habitat 2010). This global scenario reinforces the need to create and apply efficient waste management strategies in order to avoid irreversible environmental impacts. The next topic will address the methodological procedures that were used to conduct this study.

7 Methodology

In order to meet the objectives of this study, a qualitative research was chosen. According to Gerhardt and Silveira (2009), an approach that is not concerned with numerical representation but with a deepening of information understanding. In this case, using the case study technique since according to Yin (2001), the case study allows an understanding of certain phenomena from data collection and analysis.

As criteria for choosing the city to be studied, a Brazilian capital was sought, which, in addition to being recognized as intelligent and sustainable, played a prominent role in the national level through the generation of wealth and cultural diversity. Thus, the option for the city of Curitiba, capital of the state of Paraná was made.

Chourabi et al. (2012) listed a set of factors that can be used to characterize smart cities: management and organization, technology, governance, politics, people and community, economy, infrastructure and the environment. Therefore, the present study sought to analyze some initiatives in the city of Curitiba that fit into these factors, such as: transportation and mobility, green areas and public spaces, solid waste management and some general aspects of sustainability and management.

Data collection took place through secondary sources such as books, qualified articles and digital archives of the Municipality of Curitiba. A documentary survey was also conducted on the thematic documents of the 3rd World Conference on Housing and Sustainable Urban Development, held by the UN in 2016 in Quito, Ecuador, where one of the authors of this study participated as Delegate among the 10 representatives of Brazil.

For data presenting and interpreting, the discursive text was chosen, where key topics were created in order to understand what an intelligent city is and to demonstrate, through the virtues observed in Curitiba, a national example of a smart and sustainable city. These key topics were selected based on the analysis carried out in the UN Habitat III thematic documents, which the themes were selected focusing on existing actions and practices of Curitiba. In this way, it was possible to compare the themes addressed in UN Habitat III with the Brazilian case. In the next topic, a brief description of the city of Curitiba is presented and some actions are described and analyzed.

8 Object of Study

Capital of the State of Paraná, located in the southern region of Brazil, the city of Curitiba has its history and development marked by intense European influences, resulting from the migration of Germans, Italians, Poles and Ukrainians (Weiss et al. 2013). Curitiba planning began in a more intense way in 1943, through the French urbanist Alfred Agache with the creation of the Agache Plan, which proposed restructuring the road network, zoning land use, distribution of free spaces

and areas for urban expansion in order to meet the needs of its growing population of 120,000 inhabitants. From this point onwards the city began to grow and develop rapidly, with growth in terms of population of 5–7% a year, much higher than the rest of the cities of the country at the same time period. In order to deal with growth explosion, the first zoning law was approved in 1953 and in 1955 the first plan dedicated to mass transport in the city was developed (Del Rio and Siembieda 2015).

According to Del Rio and Siembieda (2015), around 1960 the population of Curitiba was approximately 360 thousand inhabitants, and as a result the need of infrastructures and services control and management increased. As early as 1965, with a population of approximately 470,000 inhabitants, Curitiba gained a new master plan, focused on the development of radial hubs towards outside the city center, growth management, industry promotion and improvement of the urban environment and quality of life, integrated public transport and land use compaction. Also in the sixties, the Industrial City of Curitiba (ICC) was created to provide economic support for the city's rapid growth and development.

Another strategy worth highlighting was made in 1966 when the Institute of Urban Planning and Research of Curitiba was created. It was composed of urban planners working outside the municipal institutional framework, with the purpose of implementing and developing projects for the city, preserving the history and consolidating urban identity. This Institute still works in present days and provides urban planners autonomy and power in decision making (Institute of Urban Planning and Research of Curitiba 2017).

Around 1970, modifications were made in the road system to redirect vehicles flow out of the center, making the city an international model of transportation and inspiring a series of projects in Brazil and abroad (Weiss et al. 2013). In the housing sector, also in the seventies, Curitiba developed a plan for relocating slums, where diverse types of housing were created in order to avoid the idea of large monotonous housing complexes. Health centers, daycare centers and recreation areas were also created close to these housing developments providing higher quality of life for these residents and mixed use of the soil (Del Rio and Siembieda 2015).

In the 1980s, work has begun on the city's cycling network, integrated with other transportation modalities and connecting important areas of the city. In 1990, Curitiba had a population of 1.3 million inhabitants and was already prominent in the urban planning sector due to transport strategies, environment, and economy, among others. In 1995, the first of the 5 "streets of citizenship" was inaugurated. These streets work as support areas of the City Hall in the neighborhoods, since they offer the population public services, points of commerce and leisure, encompassing different functionalities such as citizenship center, modal transportation station and municipal administration headquarter (Curitiba Urbanization 2017a).

According to Del Rio and Siembieda (2015) in the 2000s, the Zoning Law was approved in order to promote greater control of urban growth. In 2009, the construction of the sixth transport axis of Curitiba was carried out, contributing to issues related to the dynamics and mobility of the city. Currently, the city has about 1,893,900 inhabitants, an area of 435,036 km^2 and Human Development Index

(HDI) of 0.823, one of the highest in Brazil (Brazilian Institute of Geography and Statistics 2016). It is among the 5 largest economies in the country and is considered one of the best cities to invest in Latin America, having strong tourism and diversified industrial center, with approximately 900 factories installed, besides being noteworthy in the services and consumer goods sector (Weiss et al. 2013).

9 Results and Discussion

Hereafter, key topics will be presented to carry out the case study of the city of Curitiba, relating to what has been found in the literature, as well as in the Habitat III thematic documents, highlighting the presence of new technologies and successful strategies which contribute to urban sustainability.

10 New Technologies and Urban Sustainability

In recent decades, Curitiba's public management has been making efforts to modernize urban infrastructure and one of its main priorities is technological innovation and information democratization seeking for a knowledge society (Weiss et al. 2013). In this context, since 2007 the city has the Curitiba Agency of Development S.A., a company that elaborates and executes economic, business and technological development projects for the city (Curitiba Development Agency 2017).

As for infrastructure, Curitiba has a public safety monitoring center and a strategic information center, which allows greater control of the city and act as basis for the development of new urban projects. The city has an extensive fiber optic network, which connects public equipment and allows the population real time monitoring of the bus fleet and public health network, guaranteeing easiness of use for the population (Weiss et al. 2013). In addition, the city's streets possess accessible and free internet to all, as well as in other public areas, in order to achieve the goal of democratizing access to information (Curitiba Urbanization 2017a).

Furthermore, the city of Curitiba uses technologies to promote greater transparency and efficiency in public management, since the city has a portal of transparency since 2010, in which the population can monitor and control the use of public resources in the Municipality. The city received the maximum score in Brazil Transparency Scale (*Escala Brasil Transparente*) carried out by the Federal Comptroller General's Office and the Federal Public Prosecutor's Office. These initiatives provide greater public security regarding public management, making the community more involved with city questions and services offered by the municipality (Curitiba City Council 2017a).

11 Transport and Mobility

Concerning transportation and urban mobility, the city of Curitiba has been strategic and successful since the structural axes creation that outflow traffic from the central area of the city. It is known that the first axes began to work around 1974 and after 5 years, the city already had the Integrated Transport Network (ITN) equipped with Bus Rapid Transit (BRT). The system had different types of bus lines integrating all parts of the city and when it was inaugurated it transported approximately 54,000 passengers per day (Curitiba Urbanization 2017b).

Currently the BRT system transports around 2.3 million passengers per day and has been inspiring countless cities around the world, such as Bogota (Colombia), Los Angeles (USA), and Rio de Janeiro (Brazil) to cite a few. In 1990 high-capacity bi-articulated buses were put into operation, each of which could carry up to 270 passengers (Del Rio and Siembieda 2015). Furthermore, Leite and Awad (2012) point out that the city of Curitiba has a system of bus corridors deployed along the residential densification corridors, where bi-articulated buses contribute to the reduction of carbon emissions and increase mobility facilities for local population.

Taken the exposed into account, it is possible to observe that Curitiba invested heavily in planning and in addition, in modernizing the city's infrastructure, generating greater accessibility and safety for the population and contributing to local sustainability.

12 Green Areas and Public Spaces

The city of Curitiba has a prominent role in this sector, since it has approximately 51 m^2 of green area per inhabitant, which was due to laws creation regarding natural preservation on river banks, parks and historic district. In 2013, seven new forested areas were created in the city among parks and forests, totaling about 8 million square meters of preserved areas available for population. These public spaces, in addition to contributing to environmental issues, provide greater integration of the population with the city itself (Curitiba City Council 2017b).

13 Urban Waste Management

As stated before, as the population of Curitiba grew so did the urban waste generation. Since 1989, the city has been investing in strategies in this sector. The "Buy garbage" (*Compra Lixo*) program was implemented for poor communities in 1989 where there was no garbage collection. This program offers environmental education to the communities in which, after being educated and organized in a partnership with the City Hall, each bag of 8–10 kg of waste can be exchanged for a

transport voucher that can be used for traveling using the public transport system. In 1991 the "Green Exchange" (*Câmbio Verde*) program initiated in which residents of these regions could exchange recyclable materials for fruit and vegetables. In 1990, Curitiba received the title of ecological capital from the United Nations thanks to the application of modern techniques used for waste management. In 2007, the "Total Inclusion Recycling Program" (*ECOCIDADÃO*) was implemented, promoting social inclusion of waste gatherers through support and strengthening of their organizations (Curitiba City Council 2017c).

Currently, Curitiba has an integrated solid waste management plan that extends to 24 municipalities around Curitiba. Programs dedicated to solid waste involve everything from street collection and separation to waste disposal. In less accessible areas, such as slums, there are programs that provide food stamps or bus passes for low-income families who collect and separate their waste. In addition, the municipal waste plant, which was constructed with recycled material, employs retired or unemployed workers and after recyclable separation, it is sold to local industries. These incentive programs make Curitiba population to recycle two-thirds of garbage produced, making the city cleaner, generating jobs and income for farmers and poorest population (Del Rio and Siembieda 2015).

14 Conclusions and Future Study

In the last decades, it is possible to witness a great part of the world's population moving to urban areas and settling there, generating enormous and complex congregations of people that tend to become chaotic. Cities generate different kinds of problems, such as difficulties in waste management, scarcity of resources, air pollution, human health concerns, and traffic congestions. Therefore, new research is needed to seek for alternatives that improve life quality. Among the topics addressed in these studies, development of technologies for urban environment with a focus on sustainability presents itself as a relevant theme.

Related to this theme, the main objective of this work was to present the reality of a Brazilian city regarding the use of new technologies applied to the urban environment and to understand how they contribute to sustainability. This work presented the case study of the city of Curitiba which excels on issues related to urban development and sustainability. With this study, it was possible to identify some of the strategies developed in this city considered sustainable and intelligent, such as issues related to mobility, green areas and waste management, highlighting technologies use, which provides greater efficiency and transparency of public power towards citizens.

Information from Habitat III studies brought important contributions to be related with the case study, since it was possible to identify some of the recommendations that serve as starting point for the promotion of more sustainable and intelligent cities.

Furthermore, it is possible to determine that investing in technological development is a promising way to make cities more sustainable and promote better quality of life for people, making the residents more participative and informed, covering sustainability social aspects. Nevertheless, it accomplishes environmental aspects, as new technologies contribute to better waste management and reduced pollutant emissions from traffic, making cities more efficient. Lastly, economic aspects are covered, since new technologies promote mitigation of loss due to increased efficiency in the production, mobility and health sectors.

It should be emphasized that this study was based only on actions described in the literature. Therefore, authors do not know empirically what the real situation of the city analyzed is. In addition, this study analyzed only the city of Curitiba that as demonstrated in this study, it is a Brazilian model to follow regarding sustainability and intelligent strategies. However, it does not reflect the reality of most Brazilian cities and implementing Curitiba's actions can be difficult. This study was based on the analysis of some key topics, however, it should be emphasized that they are not the only topics related to smart and sustainable cities, but rather the main topics found regarding the city in question.

Finally, it is considered that to replicate the strategies presented in this study in other locations, short- and long-term actions focused on citizen participation and investments in technologies that provide agility and greater facilities are needed. For future work it is suggested to investigate the opportunities and barriers to make Brazilian cities smarter, like Curitiba.

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Communication as a Tool for Expanding Social Participation: The Case of the Rio Operations Center

Alexandre Hojda and Pedro Reis Martins

Abstract This article highlight the relation between the use of Information and Communications Technology (ICT) and the social participation in Rio de Janeiro city, through the social and midiatic engagement strategy of Rio Operations Center (COR, in Portuguese)—an urban command and control center launched in 2010 to assist the logistic city management. This COR's strategy is delivering new and interactive contact channels between the government and society, by using communication tools that contributes directly with social empowerment in the city operational management. As a result, citizens were able to use these channels to dialogue with the city logistic managers, in order to be well informed about emergencies and to report urban problems straight to the response teams. Instead of being passive observers, citizens have the opportunity to be actors in the city operations field by using COR's communications channels. This text will present four perspectives of COR's communications strategy: (1) press companies engagement in the city's operational routine; (2) the use of web social media tools to engage citizens; (3) partnerships with urban mobility mobile apps and (4) live video broadcast in the internet to communicate crisis situations. These items increase the society participation and urban resilience, improve the local management, minimizing urban problems, save lives during emergencies and contribute to a better quality of life.

Keywords Rio de Janeiro Operations Center (COR) · Information and Communications Technology · Smart city · Social participation Urban municipal management

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1 Introduction

One of the largest cities in Brazil, Rio de Janeiro has an urban complex dynamic with more than six million inhabitants, a conflicting geographic characteristic for metropolitan area (included several tunnels, hills, beaches, bay and lakes), and an enormous social gap. This scenario is impacted by problematics public police that many times are discontinued and without the support of long-term planning. In this context, the use of tools such as the Information and Communication of Technologies (ICTs) appeared as an attempt to contribute to face the challenges of the cities, giving support in the collection, organization and analysis of data and improving response capacity of the cities.

Rio de Janeiro City Hall implemented an integrated solution in order to improve the management of the city operation: the Rio Operations Center (COR, in Portuguese). COR is an urban Command and Control Center (CCC), inaugurated at the end of 2010. This Operations Center contains modern technology for monitoring urban routine and integrating over forty agencies and services in the same place to support the decision-making process in day-to-day management of the city, mega-events and crises. The research object of this article is how COR's communications strategy is working to stimulate the citizen's participation in the urban operations. This participation happens in a two-way communication flows, where COR inform the citizens for a better decision making in their routines in Rio de Janeiro and, in turn, citizens inform COR about situations they testify in the streets.

One of the important aspects of urban management is to encourage social participation, and ICTs can contribute for this topic, on one hand to increase access to information (Gil et al. 2015) and on the other hand offering tools to shorten the distances between the government and society, fostering inclusion and facilitating the empowerment of people. In this sense, Steenbruggen et al. (2015) emphasize that city intelligence must occur on two fronts, the first being in ICTs applied to urban management, as it helps to improve processes (via better data use) and city responses, but it is fundamental to involve a second effort to stimulate the "intelligence" of the city through investment in human capital and increasing social participation.

The focus of this paper is to show three points: firstly with ICTs, how COR is using the communication to bring the government and citizens closer together; second, how this changes can contribute to improve the social participation; and third contribute with some relevant information to others cities use this kind of technology.

Besides this introduction, the text has the follow items: the second part details the methodology used; the third component covers the theoretical referential of smart city; the fourth item presents some characteristics of Rio de Janeiro city, object details, the use of the CCC to the urban management and the details about modus operandi of the Rio Operations Center (COR) to the urban municipal management, with focus in the communication between government and citizen. In the paper's conclusion, some aspects of ICTs and social participations will be

worked and the contribution of the paper will be some relevant information about replication of this instrument in other cities.

2 Methodology

This article is part of a wider research on the sociotechnical construction of the COR in the context of the smart city. For this paper, the methodology involves a case study, supported with bibliometric search and a descriptive research. In the first part, the bibliometric, was collected with the use of keywords (connected with theoretical of the use of technology in the urban management, smart city, CCC, control room, situation room, crises room, Big Data, ICT, and COR), in research websites (Periódicos Capes, Redalyc, Scielo, Academic.edu, Research Gate, Scholar Google, Read Cube and Science Direct).

The other part, involved the descriptive research, was used by the authors during the experience with the object to collect data. It is relevant to mention that, in this part of the methodology, authors adopted the "observant participation" research model (Wacquant 2002), allowing the analysis to be enhanced by the experiences of an insider (a professional that worked inside the CCC), providing a broader and deeper view of the COR.

3 ICT, Smart City and Social Participation

Cities are a result of a combination of resources, strategies and actions, influenced by politics, economic, climate contexts and physical limitations, which create urban challenges that demands planning and improving the management (Lemos 2004). The use of ICT is one relevant alternative to deal with these challenges, contributing to increase the information flow in urban area and subsidize the urban management to offer benefits to the society (Goodspeed 2015).

Until today, the concept of "smart city" doesn't have a unique and precise definition, and it has been applied to indicate the massive use of technology and information, integrated with the "traditional" factors of the city, forming an interconnected and inseparable "system". In practice, there is an attempt to optimize the city existing structures by enhancing its efficiency, through better services and response to urban problems.

According to Bettencourt (2013), cities are relevant creators and users of data. The growing of data generation, capture and organization (transforming data in information/knowledge) might be understood as a stimulus for the development of the urban systems through interactions between citizens, productive sector and government institutions. In this sense, with more information, better will be the "use" of the city and the prevention for the urban problems (Harrison and Donnelly 2011).

In this logic, ICTs to generate data can subsidize the urban management to reduce the inefficiency of current urban systems. With more information's sources, it is possible to identify problems faster, engage rapid responses, contributing to enhance efficiency to operational public services. These data come from different sources, like sensors, cameras, cell phones, social media and it tends to contribute, not only to minimize problems impacts, but to future planning actions, enhancing the city dynamics, and the citizens' participations (Steenbruggen et al. 2015).

In the way to consolidate the use of information in the social participation process, Komninos (2006) points out the importance in the training processes to improve the social participation and members of public management. Therefore, the author suggests two directions: the first is that all processes should be integrated and focused on society, and the second is that knowledge should be the basis of the decisions. In this sense Harrison and Donnelly (2011) emphasize the relevance of information and integration between government and citizen in the construction of the intelligence of the urban management processes.

In turn, about the intelligence of the city, Citrigno et al. (2014, p. 42) emphasizes aspects of empowerment of the citizens and urban operators, who become the main tutors of the territory, the so-called "social sensors", for the detection of critical situations in the urban territory.

Klauser et al. (2014) expose the concept of smart city in three points: data generation and information in the first part; the second is human capital, qualification and participation; and the third show the relations and interconnections among the institutions, as relevant arrangements, in order to reorganize the smart city. Lastly, Kitchin (2014) organize the smart city conception in two relevant elements: the first cover ICTs and data and the second are related to human capital (qualification, participation and co-operation).

4 Description of the Case Study

Rio de Janeiro city has a peculiar topography, added to heavy summer rains, resulting in flooding, mudslides and landslides occurrences. With the mega-events prospect (the 2014 World Cup and 2016 Olympic Games), the city was in an uncommon moment: the sum of the friendly relations between the three levels of government (federal, state and local government), to enable the mega-events and internationally project the image and tourism of the Rio de Janeiro's city Fig. 1.

The COR was inaugurated on December 31th, 2010, as a workplace dedicated to the integrated response management for emergency situations, and to take care of the city's operational routine, crises and mega-events.

For this integrated performance, was created a work team with representatives of public services agencies that start to work in the same room (the Control Room, inside COR). This work place was implemented with wide technological integration of data and information from different departments and public service agencies, with which the COR actors developed integrated monitoring actions to city

Fig. 1 Details of Rio de Janeiro's topography. *Source* https://www.flickr.com/photos/riotur/7972355632/in/album-72157630371640200/ Consulted: June 20, 2017

operations. When the municipal management take action by the use of urban CCCs, the monitoring and surveillance ability extends (one operator can monitor multiple cameras at the same time). Moreover, with modern technologies and software, this capacity is still more optimized (Cardoso 2010).

In Illustration 1, is possible to observe, before the COR, the problems of the city was respond isolated in each department of the city. With COR, this dynamic changes and now the problem comes by one department of the city (from press or other instrument etc.), this information goes to the COR coordination of the control room, and this actor will take the decision about: who will be involved and what is necessary to resolve this problem in less time and impact for the city.

To monitor the city in real time, COR's infrastructure has approximately 800 municipal cameras installed throughout the city (in addition to the partners cameras, the number increase to 1200), a municipal meteorological radar, GPS devices installed in buses and municipal vehicles, and several other sensors that provide data such as transport system, traffic conditions, rainfall intensity and level of rivers and lakes.

All this technology is added to the information offered by partner institutions, resulting in a broad connection between different types of data that are displayed and monitored in the COR's Control Room, in a video wall with 100 m^2, where it can observe intersections of more than 250 information layers, detailing each region and service of the city, in a 24 h a day, 7 days a week continuous operation (it is the "24/7" operation concept, as will be used in this article for the next mentions to

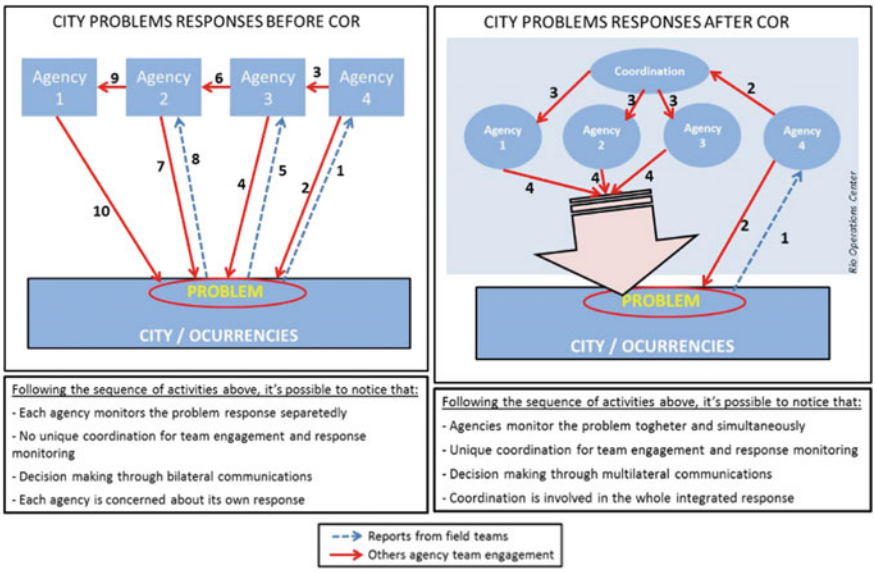


Illustration 1 Dynamic in the operations of the city: before and after COR. *Source* Rio Operation Center. Consulted: June 15th, 2017

Data integration softwares	Cameras avaiables	Sensors monitored	Data sources integrated in COR
Softwares to cross data from different sources to support sityuation analysis and decision making	Street cameras owned by Rio City Hall and partners	Sensors used to monitor city assets and other urban conditions (rivers' level, rain intensity, etc)	All sources of data that COR integrate in its systems to monitor the city
5	1200	+ 50	+100

Illustration 2 Characteristics of information. *Source* Rio Operation Center. Consulted: June 18th, 2017

indicates uninterrupted operations). The Illustration 2 offer the characteristic of the information in the control room.

COR is organized with many communication channels for the exchange of information with society: profiles on web social media managed "24/7" (Twitter and Facebook, mainly); the "Central 1746" (unified phone for citizens service); integration with urban mobility apps, such as Waze and Moovit (the first is devoted for private transportation and the second, with the use of public transportation); besides the strategic relationship with local news media companies. With information from the City Hall weather team, the municipal Civil Defence manages emergency services within COR, such as the warning system siren (for risk areas) and communication by text messages (SMS) via mobile phone.

In this way, the integration of information and actors within COR provides the increase of the risk predict capacity and society mobilization in crisis situations; reduce response times to problems; offer a better view about the urban operations possibilities and consequent optimization of the resources.

5 Analysis of the Case Study

With the COR implementation, some changes happened in the Rio de Janeiro's urban management, that in turn, reflected among other points, in the communication between government and society. Hereinafter, it will be detailed some of these sociotechnical constructions.

In COR, the communication service is used as an operational tool to inform the citizens about the city's operations (for better planning their routines) and to mobilize them in emergency situations, guiding people about how to stay safe and to minimize impacts of city problems in their lives. The perspectives of this public relations work front involves direct communication with the public using web social media tools (specially Twitter, Facebook and Instagram); partnerships with urban mobility mobile applications (Waze and Moovit are the most relevant examples); and a strategic approach with the local media companies.

Although, to understand the contribution of COR's communication strategy to improve the social participation, it is important to analyses it from the perspective of the government challenges and its efforts to be more prepared to overcome crisis and other medium-size impact operations. In order to face these complex challenges within the urban context, technology and information are critical to boost the relation between government and society.

Daily, the information about operational conditions in the city (weather forecast, traffic and transport situation, interventions implemented and the impacts) are transmitted "24/7" by COR's public relations team for the citizens, through the radios, TVs and news websites or, directly, by web social media channels. Nowadays, all the main city's press companies keep permanent reporters in the COR's Press Room. With the web social media communication services, COR has established a rising direct audience (in May 2017, almost 800,000 social media profiles was following COR). Thus, summing the audiences of local press companies and COR's social media, now the City Hall has thousands of 'eyes' monitoring the city, creating a network of active and vigilant citizens that alert the Operations Center always when they verify situations which may affect Rio's routine. With this new source of information, the Operations Center can identify problems and engage the necessary solutions faster. More than that, COR also gets greater communication capacity to mobilize the citizens, which is a powerful skill to deal with urban emergencies.

With the Illustration 3, is possible to understand the way of information and how the decision will be constructed. When one problem happen in the city, this information will arrive in the COR, coming from field teams, cameras, sensors or

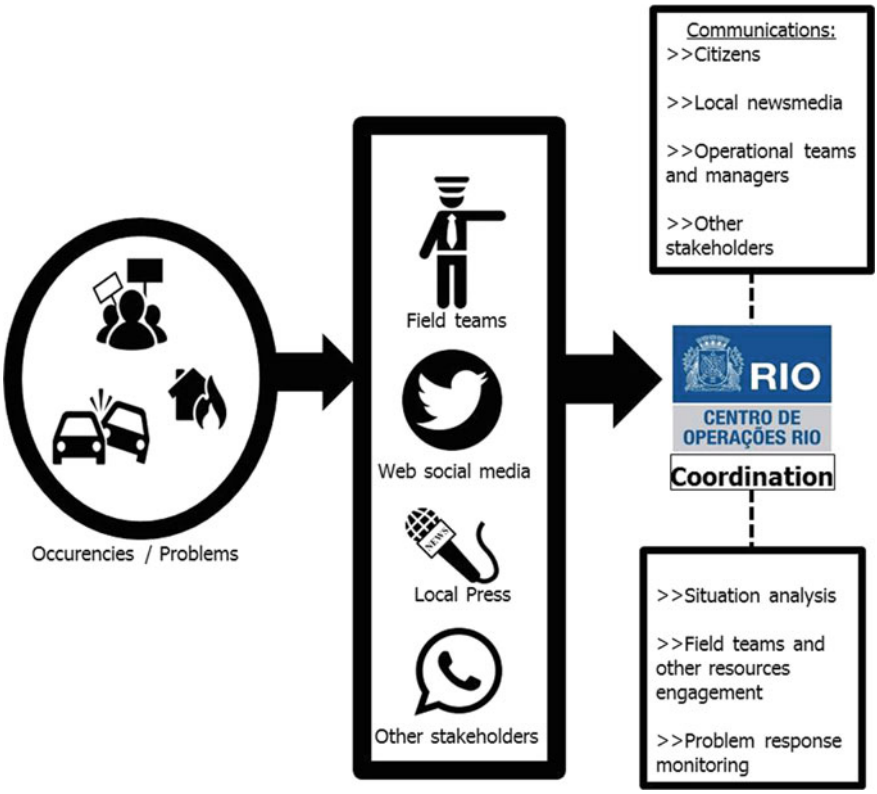


Illustration 3 The way of information until the action. *Source* Rio Operation Center. Consulted: June 17th, 2017

from the society and the operation center will organize the decision to the future action and inform the citizen about this decision and the possible consequence.

In this way, there is the construction of a "win-win" relationship between COR and citizens. It is a positive result of social innovation—as it is not cultural in Brazil, or even common, for local governments to hardly to use the communication as a continuous strategy to build city resilience expecting short/medium term results. In this context of two-way communication, as the COR's audience increase, the greater is the municipality power of social engagement in the city.

Bellow, there are overviews about four of the most prioritized communications efforts implemented by the COR's public relations team: (1) press companies engagement in the city's operational routine; (2) the use of web social media tools to engage citizens; (3) partnerships with urban mobility mobile apps; (4) live video broadcast in the internet to communicate crisis situations. The following are detailed each of these efforts and their relationship or influence on social participation.

(1) **Press Room and the media engagement in the urban operation routine**

Since the beginning of the COR's operations, the strategy of relationship with the local media aimed to shorten the distance among the government and press companies (radio, TVs, newspapers and news websites). The journalists from the main press companies of the city started to work in COR's Press Room since the first months of COR's operations. For them, the COR's service, initially, was limited to the supply of information in real time about the urban logistic operations.

On this basis, the local radio show hosts started to use the phrase "…live from the Rio Operations Center…" to announce, several times per day, the live participations from their reporters in the Press Room. This new dynamic, where the press companies use the official information, add credibility for the news. This is why, besides of media receive real time official information, in a short period of time, they began to use COR to inform situations reported by their audience (citizens) who circulates throughout the city. These press audience information was absorbed by the Public Relations team of the Operation Center and each new case reported by journalists, was informed straight to the COR's operational teams. If confirmed, appropriate actions is taken to respond the situation reported, and journalists receive back the details of the case (what is happening and which response is being applied) and recommendations that should be given for the citizens.

In this interaction, it is possible to observe one first perspective of a "win-win" relationship between the City Hall/COR and local press actors. COR wins a new group of partners, compound by the news media audiences that reports, regularly, problems witnessed in the streets. In the other side, the press companies get a new official service of information, in real time, with a notorious level of customization for each specific report informed by journalists (confirming reports, detailing the response actions to them and orientations to citizens, if necessary).

Consolidating this integration involving COR and the local press, the next level was use the Press Room capacity of spreading emergency information. When is necessary to engage citizens about a critical situation, the Public Relations team use the local press support in the Press Room to inform with relevant agility: with only one telephone call for journalists in the Press Room, thousands of people from the city receive messages by COR in only a few minutes, using the press partners.

In this way, it is possible to observe the second perspective of the "win-win" relation generated by the strategic relationship of the COR with the local media institutions. The local media offices reinforce their public utility function, receiving in first hand and in a quickly way the official recommendations defined by the City Hall to the citizens about how to deal with crises. The COR, in the other hand, increase the City Hall's capacity of communication in emergency events.

To manage this work relation between COR and press services, two important topics will be introduced. First, the creation of communications' protocols, focusing in facilitate the journalists comprehension about not only the relevance but also the urgency level in each kind of COR's communications. Second, COR promoted the local journalists to a new kind of insertion in the urban operation routine. In this new position, this group turned to play an actor-function in the city's operational

life (and stopped to be just in a critical position about urban logistic management—the normal journalist attitude in the past).

Organizing this "two way road" among the operation and the press workers is one of the most important activity in the COR Public Relations department.

(2) **Web social media and the COR's citizen virtual community**.

In 2010 and 2011, before the institutional website, Twitter was the first COR's channel for communication. From there, the investment in human, material and technology resources to manage the social media channels increased continuously. The main result of this process is an audience of 800,000 followers in the social media, reached in May 2017. The focus in the social media is to stimulate the interaction with the citizens without third parties' intermediation, creating a new platform to inform the society and to receive social data/reports about urban problems.

To improve efficiency, each social media receives a singular attention. In the first months of COR's operation, it was only publicized the official information about urban operations, and the focus was mobility and weather forecast.

In 2011, COR reorganize the communication strategy and start to provide more information and the interactions with users had relevant increment. This new moment involved, firstly, demands for information in COR's social media implied doubts about better ways and routes for displacements. Second, citizens started to be more participatory and more interactive, sending information about city problems. In this way, to provide information for citizens, turned in to COR's communications department priority. Thus, the communication between government and citizen without press companies, started to be a strategic asset in the COR.

To keep growing this audience and Internet interaction levels, the editorial guidelines of the web social media publications have been optimized and adjusted, based on, constant evaluations and updating planning. In this sense, the more interactions there were in COR's social media profiles, the more relevance it will be COR messages about the city operations. On Facebook, for example, the more interactions one follower has with the COR's profile, the more COR posts this social media will show in this user profile. This boost in the popularity of the COR's information in social media influenced positively the increasing numbers of followers.

Besides of real-time information, COR diversified the posts, publishing public service campaigns, contents of partner agencies, and details about the more impactful-programmed interventions. It is also important to emphasize one of the adjustments that showed efficient results: add sense of humour to COR's posts. The humorous tone was introduced in the messages that did not cover emergency issues or affecting negatively the routine of Internet users. This measure had a positive impact to increase the number of COR's subscribers on the web and the level of interactions with citizens.

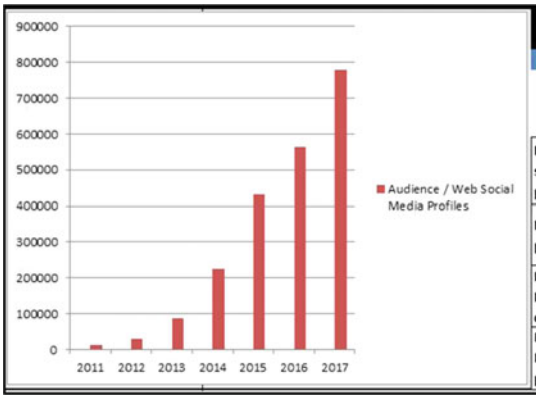
It is possible to observe the positive result of these web social media editorial measures in numbers. In a common day, without any emergency situation during the period, the COR's web messages sent reach around 800,000 web social media

profile's—with approximately 30,000 interactions and 750 new profiles subscribers per day—summing all social media channels. Within a day that there are emergencies or other problems in the city, these numbers grow expressively. In this kind of days, COR public relations team registered audience peak of more than 2 million social media profiles reached by COR's messages, with almost 80,000 web interactions with citizens and around 2200 new profiles subscribing to COR's communications web channels. These statistics are provided by the social media channels used; Twitter and Facebook are responsible for the majority of these numbers. It is important to point that one unique person can have profiles in different social media platforms, and, in this case, will appear more than one time in these large numbers.

In the Illustration 4, there is a comparison of two days in January of 2017. The 12th day was an emergency day ('Days w/ Emergency Situations') because of heavy rains that impacted severely the city. January, 24th had a normal routine dynamics ('Regular Day'), without any critical occurrences impacting the daily routine. Comparing these two days, it is possible to see how COR's web social media quantitative indicators vary when crises occurs in the Rio. During these emergencies, COR's messages can reach over 2 million social media profiles in a city that has a population of 6.3 million. Illustration 4 also shows the rising of the web social media audience since 2011.

Still in the Illustration 4, is possible to observe the social media engagement in the regular day, comparing with emergency, when the interactions between COR and society grows more than double, the visit to the profile almost multiple three times and new followers has an important increase. With this intense and increasing use of COR's profiles in web social media, a citizen virtual community was created to monitoring in real-time information about the city's operational conditions.

As an integration department of city public services, COR is seen by citizens as the City Hall itself. Citizens ask to COR social media profiles a wide range of questions, including topics related to other agencies' responsibilities. To provide



Rio de Janeiro City Population: 6,3 million people		
COR'sWeb Social Media Engagement		
	Regular Day	Days w/ Emergency Situations
Messages sent by COR per day	150	240
Interactions per day	30.000	76.800
Profiles Reached per day	800.000	2.158.000
New Followers per day	750	2.255

Illustration 4 Interactions in the urban routine and in the emergency. *Source* Rio Operation Center. Consulted: June 17th, 2017

quickly answers to these questions, COR's public relations team involve other city agencies communications managers as information sources. In this sense, COR virtual community is very critical: they demand quick answers for questions sent and also post negative messages when COR's messages are related to controversial topics (like in the case of partial fall from a bicycle lane near to seafront of the city, in 2016). However, majority of opinions are positive about the information service offered by COR in the web.

Commonly, virtual citizens that follows COR social media profiles defend Rio's CCC, when other internet users criticize COR service with unfounded arguments. More than that, as COR's social media more experienced users have a high level comprehension about the city operations, they usually answer simple questions made by recent followers, without any intervention of COR's web content administrators. During emergencies, it is when COR's social media profiles has its audience peak. This highlights that COR web communication platforms consolidated as reference for information and guidance on emergencies and urban crisis.

Observing these characteristics of the citizens' virtual community built by COR, it is possible to see how web social media is used by Rio residents to send and receive useful information about "24/7" city operations. These tools democratize communications, enhancing the empowerment of the government actions by citizens, using low cost technology solutions. In the week days, COR start problems report checking from citizens' messages around 5 times a day, taking into account direct messages through web social media and people that report problems to local news broadcast companies (that, in turn, send the report to COR' public relations team).

(3) **Partnerships with mobile apps of urban mobility**

Partnerships with mobility mobile applications are also an important COR's communication strategy to expand the channels of communication with citizens. Such as web social media, communication through these apps has the characteristic of being almost a direct interaction with the citizen, without the intermediation of the local press companies. With thousands of users in Rio, the two most significant examples of this strategy are the partnerships with Waze app (dedicated to the planning of trips in private vehicles), Moovit and Trafi (both to plan trips using public transportation).

The first partner was Waze, since 2013. Waze users' notifications on traffic conditions in the city were integrated into the GEOPORTAL, the urban management software developed by the COR's technology programmers team. Nowadays, traffic jams and accidents, when informed to Waze, are displayed directly on the COR monitoring screens and field teams are, rapidly, notified to check the situation. In this partnership with Waze, COR also used the app to send city information for users. Interdictions on streets, due to serious accidents or scheduled events with significant impact, began to be reported by the COR for the Waze. This information were inserted into the application maps and, when drivers consulted routes in the

regions of these interdictions, the app has already recalculated the indications of better routes, considering temporary changes in the traffic informed by COR.

Attending to necessity of communication for Rio 2016 Olympic Games, this partnership was involved with other mobility apps Moovit and Trafi. The main demand, in this case, was to send information to Olympic spectators (using mobile phones) on how to go to destination using the transport infrastructure of the city. This communication strategy took into consideration the new transport lines, the new intermodal stations (which allows connections between different modes on the same platform) and the large number of people, from outside of Rio de Janeiro, present in the city for the mega event. Considering all notifications sent to users, messages published in the app was read over 400,000 times, during the Olympic Games.

Other partnership consolidated for Rio 2016 was with the main taxi service applications. Approximately, 20,000 taxi drivers received information about the urban operational problems or simply orientations for them, in order to inform their passengers. All these initiatives for communication via apps are treated as Olympic legacy for the COR, and nowadays, they are being adapted to be used as new channels of communication with the citizen, in the urban routine. In this way, the new partnerships have enlarged communication in "two-way" between COR and citizen.

The use of mobile applications has adhered to the idea of urban resilience and offers a new mechanism for exchanging information with the citizens, which can boost the first steps of social participation (when, for example, citizens are able to send problem reports to COR) and improve the management of the city daily routine.

(4) **Live video transmissions as a new resource for a massive communication service**

The live video transmissions (that will be called just as 'lives', from now on in this paper) is a relevant resource that COR started to use in the end of 2016. These 'lives' are broadcasted simultaneously through four web social media platforms: Facebook, Twitter, Periscope and YouTube. As these platforms (especially Facebook, Twitter and Periscope) valorise live videos and automatically notify users while they are being broadcasted, this new resource boosted the level of citizens mobilization and engagement through COR's social media profiles. This boosting—most noticed in Facebook—happens in regular days and, more intensively, during emergencies. For example, while a Facebook regular post (text, image and static) about an emergency can reach 260,000 profiles and 6000 interactions, a live video post (about a similar situation) can be seen by 820,000 profiles, resulting in more than 14,000 interactions (comparing posts published in April and May 2017).

In this way, in the first semester of 2017, the live videos are the most powerful tool, in terms of people's engagement. One important mechanism that drives this engagement (mostly observed in Periscope and Facebook) is the automatic notifications send to cell phones for users that access these web social media using

mobile devices applications. This mechanism allows COR's send real time information to citizens, wherever they are, enhancing the impact of COR communication service. With that dynamic communication tool, people receive live video broadcasts in mobile devices, with official recommendations, city street cameras images and other useful information.

Besides the 'lives' for emergencies, other content transmitted in these videos are interviews with operational managers from different city departments. This kind of content has reached a relevant number of views and interactions open an interactive channel to detail city operations that did not exist before. Topics like the city operations for street carnival events and vaccination campaigns are between the ones covered in the 'lives'.

To produce these lives, besides the regular investment in human resources, the investment in technology made by COR can be considered as a very low cost one, compared to major public investments in communications initiatives. Despite of it, with this new way to communicate allowed COR spreading the messages faster and to a huge number of citizens. By doing this, COR offer information about critical city's issues, also providing mechanisms for people easily to share these lives using web social media platforms. In this sense, COR's lives are a powerful channel to bring government and citizens closer together and to increase space for social participation in the city operational management, in this way, touching the emphasis of Harrison and Donnelly (2011).

The COR's public relations team is working to insert in these videos even more data provided by urban sensors that are monitored in the Rio's CCC. In that way, detailing the operational routine, the impacts and recommendations in crisis situations, and other specific city operations, the 'lives' contribute to show people the complexity and particularities of government operational actions. By knowing it better, citizens are able to understand and monitor the City Hall operations, as the expectations about these actions are more aligned and transparent. It constitutes one more two-way communication platform, as it is a direct channel for people to send suggestions and to charge more quality in public services. On the other side, observing the 'lives' in emergency situations, it also contributes for more urban resilience, once a bigger part of the city knows exactly how to protect themselves because they received COR's notifications and real time information through their mobile devices, being able to act more quickly.

6 Conclusion and Paper Contribution

Reflecting upon the municipal management scenario, there is a relevant demand to improve the integration between actors involved in public management, and to provide more citizen participation in city management processes. This occurs because, in general, the Brazilian's reality is not the planned pursuit of public service efficiency, but rather short-term, isolated and discontinuous in the public policy.

Before the COR's implementation, the Rio de Janeiro's City Hall had a less integrated operational management, with the departments working in a lower level of coordination, which resulted in difficulties to identify those responsible for problem's responses, that require fast actions, with multiple actors involved. COR stands out as a stimulator of adjustments for the urban management of Rio de Janeiro, contributing to a "24/7" integrated monitoring, what is helping to drive improvements in city operations, not only in real-time responses, but also to reorganize the communications process ant the relation with the society. Despite the use of technology in the city management comes from private sector pressure and influence from some project from developed countries, this Brazilian experience in the use of control room for urban routine is so singular and difficile comparison with other initiative around the world.

Some facts of this new reality converge with the theoretical authors of 'smart cities': Goodspeed (2015) argues about the citizen benefits when the government offer information around urban problems using ICT. In this perspective, the use of ICTs and the creation of a Press Room (with journalists working "24/7"), not only permit this change in municipal management, but also add a kind of "permanent audit" which analyses if discourse and practice are being well managed by the government. If the announcement of a new operation is done, but results do not match with what was announced, the complaint of press and citizens is unavoidable. To complete the relation, this practice converges with Steenbruggen et al. (2015) when the authors emphasize the use of technology impact citizen's participation.

In this way, the rising information capacity, contribute to improve the communication between government and citizens, and Komninos (2006) was correct to affirm about the importance to instruct society with data and information to increase the social participation.

The "two-way" communication between COR and citizens, beyond generating relevant contributions for the operation of the city ("thousands of eyes" monitoring the streets and extenting impact of the emergency messages communicated by COR), increasing the level of involvement of citizens and local press actors with COR, it also contributes to the materialization of COR's integration purpose. As citizens and journalists keep themselves informed, daily, about the public responses to events that affect the city's routine, it raises the transparency in these processes and the reliability in public actions. This proximity of society with the city's operations allows citizens and journalists to supervise actions performed by COR, which also increases the level of exigency for COR puts into practice all the "smart city" benefits previously advertised.

The fact that the media is in the COR's press room working to inform the society causes not only an increase of interactions between the two groups (city operational teams and the journalists), but improve the capacity to make citizens protect themselves, in order to be less vulnerable and to know what is happening in the city in real time. This new relationship open new channels for social participation and collaborate to a better life quality for citizens.

One important contribution of this paper is to offer information about the possible replicability of COR's processes for CCCs in other cities. First, a relevant topic is the decision of using communication with citizens as one tool for the urban operational management within the CCC, including there a workspace dedicated for local media companies' journalists. The other highlight was the decision to invest in virtual communications solutions (specially, web social media platforms) to implement a direct communication to the population. These decisions brought government and society close together, widening the knowledge exchange between them.

As important as the technological solutions to build and support the COR's communication channels with citizens and local press companies, it is the information management for these two different publics. In that way, a key decision in COR's case was to invest in a journalism and public relations professional team, responsible to manage COR's 24/7 communication operations.

Bellow, there are other three lessons learned during the implementation of COR's communication strategy that can contributes with similar CCC projects in other cities:

(A) **Diversity of topics that impacts in the city's daily operational routine**—if an event impact the city's mobility or the citizens' safety, it is important that the CCC communicate the problem, its impacts, and recommendations about how people should deal with the situation. To mention a few examples, there are heavy rains flooding streets, public transport problems or public safety occurrences affecting urban operations. In this sense, the CCC communications challenge is about not only the variety of operational issues covered by the CCC, but also the quickly decisions about the need to communicate unexpected statement, during urban emergencies.

(B) **The CCC must communicate or facilitate the communication, even when the issues, not involve actions that the CCC is responsible**—one of the main contributions of a CCC is the integration between operational actors within the city. This integration must also make the information from different departments to be consolidated in the CCC workspace, in order to respond existing demands (operational, press or even citizen's demands). In that way, the CCC should facilitate connections between the operational actor that demand information and the other one that is responsible to offer this information. When a demand comes for the CCC, the answer "we don't know nothing about this operational issue, because it is not a CCC responsibility" should not exist in the CCC. Instead of this kind of answer, the CCC must facilitate the fact-finding, if needed.

(C) **To be the official source of information about the city operations**—one deliverable of COR communication team is the daily real time reports produced about city operations. In Rio's case, COR manage the operational news about the city, positioning itself as the official source of information about urban operations and emergencies.

Considering these three highlights, each city's logistic problem or a simple citizen demand are opportunities to present details about the city gears and the processes that sustain the city operations. The response actions for city problems or a more simple public demand about an urban occurrence (a question posted in a web social media platform, for example) must be communicated to citizens, including the factors "behind the scenes" of the city operations and the relevant elements for the response actions. This strategic exposition contributes for the credibility of the system and contributes to offer more information about the city operations, strengthening the citizen empowering process within the public management and providing more knowledge about the urban operations complexity. It all affects positively in the social participation, through new communication tools.

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Sustainable Housing Through Sustainable Planning Practices: Challenges and Opportunities for Formal Housing Provision in Nairobi, Kenya

Collins Sasakah Makunda

Abstract Rapid population growth and urbanization is a phenomenon that is characteristic of numerous cities in the global South. Nairobi, a rapidly urbanizing city in Kenya, and also the regional hub of East Africa, is no exception. This growth has resulted in enormous pressure on the city's urban infrastructure in tandem with a high demand for formal housing for the increasingly affluent residents. Historically, the trend has typically been the growth in informal settlements to meet the growing housing demand of poor and low income residents who constitute the majority of the city dwellers. However, in recent years, while the historical trend has continued unabated, the new phenomenon of a rising middle class has increased pressure on the existing limited formal housing stock. This has resulted in the rapid transformation of the extant low-rise single family housing units, mostly bungalows, to high-rise multi-family housing units, in the form of high-rise apartment blocks. This paper evaluates this transformation in housing and highlights the unsustainable way in which it is occurring as evidenced by negative externalities. It concludes with a discussion of possible strategies that could be employed to ensure more sustainable urban planning to address the need for sustainable housing. And in fostering the understanding of lifelong learning and education in healthy and sustainable cities, this chapter hopes to achieve a clearer understanding and appreciation of the fundamental issues that need to be considered, contemplated and addressed in ensuring sustainable outcomes despite the fluidity and dynamicity that accompanies change, which is inevitable in a complex system such as a city.

Keywords Urbanization · Nairobi · Housing transformation
Sustainable housing · Sustainable planning

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1 Introduction

Rapid population growth and urbanization is a phenomenon that is characteristic of numerous cities in the global South. Nairobi, a rapidly urbanizing city in Kenya, the capital city of the country, and also the regional hub of East Africa, is no exception. In tandem with the country's rapid population growth, the city of Nairobi has experienced accelerated population growth since Kenya gained independence more than half a century ago. By the time of the 1969 census, five years after Kenya's independence, the city's population was 509,286 persons (Kenya National Bureau of Statistics [KNBS] 1969). In the 1999 census the city's population was 2,143,254 persons (KNBS 2001), which had risen to 3,138,369 persons by the 2009 census (KNBS 2010)—an increase of approximately 100,000 per year over the decade. The United Nations (2015) estimated the city's population to be 3.9 million in 2015 (United Nations 2015). This growth has resulted in enormous pressure on the city's urban infrastructure as well as a high demand for formal housing for the increasingly affluent residents. Historically, the trend has typically been the growth in informal settlements to meet the growing housing demand of poor and low income residents who constitute the majority of the city dwellers. Estimates put the figure of those who live in informal settlements at 60% of the city's population (United Nations Human Settlements Programme [UN-HABITAT] 2003).

However, in recent years, while the historical trend has continued unabated, the new phenomenon of a rising middle class has increased pressure on the existing limited formal housing stock. Shah and Ruparel (2016) have documented the progressive increase in the middle-income population in Kenya. Their research indicates that their numbers have grown from less than three million to more than five million over a span of six years, between 2006 and 2012, and projected to increase further (Shah and Ruparel 2016). At the same time, the World Bank (2017) notes that Kenya's Gross Domestic Product (GDP) has maintained a steady rate above 5% growth for the last four consecutive years (World Bank 2017) indicating a thriving economy and the potential for the middle class to expand further. Additionally, other markers of a growing middle class such as an increase in car ownership and the growth of mega Malls has been characteristic of trends in the city. And with Nairobi as both the capital and primate city of the country, it is no surprise that most of the middle class have clustered in the city and especially in areas easily accessible from the city's central business district (CBD).

This growth in the middle class has resulted in a high demand for formal housing leading to the rapid transformation of the extant low-rise single family single unit housing units, mostly bungalows, in historically well-planned and serviced neighbourhoods, to high-rise multi-family multi-unit housing units, in the form of high-rise apartment blocks up to thirteen floors in height.

The unsustainable way in which the housing is currently being produced to address the market need and demand for housing is thus the primary concern of this chapter, which seeks to not only highlight the challenges of the prevailing situation but also suggest some of the opportunities and strategies available through

sustainable planning practices for pursuing the transformation of housing to meet the formal housing need in a more sustainable way that ultimately enhances the quality of life of the neighbourhood and city residents.

This chapter was informed by research undertaken to better understand the effects of rapid transformation of housing in fast growing cities in the global South. While extensive research has been undertaken on informal housing in these cities, limited scholarly work has been undertaken to understand the dynamics of formal housing provision in this context thus limiting the scope of understanding of the complete picture of the housing situation in countries that are experiencing rapid population growth and high rates of urbanization.

And in fostering the understanding of lifelong learning and education in healthy and sustainable cities, this chapter hopes to achieve a clearer understanding and appreciation of the fundamental issues that need to be considered, contemplated and addressed in ensuring sustainable outcomes despite the fluidity and dynamicity that accompanies change, which is inevitable in a complex system such as a city and especially one fraught with contradictions and a preponderance of challenges as those in the global South.

2 Conceptual Approach

Thirty years ago, the World Commission on Environment and Development (1987), chaired by Norway's former Prime Minister, Gro Harlem Brundtland presented a report titled, *Our Common Future*, or the *Brundtland report* that defined sustainable development as one, "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 [WCED] 1987). The report is commonly understood to have proposed a balance between the economic, the social and the environmental components of development. However, over the three decades since the release of the report, it is arguable that the economic dimension has been privileged over the social and the environmental dimensions in prevalent approaches to sustainable development. Commonly used econometric measures such as GDP, used as indicators of sustainable growth, fail to take into account the negative social and environmental consequences of many economic activities. Consequently, the positive economic measures of development, encouraged in discourses on and targeted in strategies for development, are inadvertently leading to unsustainable development. As will be demonstrated in the subsequent discussion, the reality is no different in the case of formal housing provision in the city of Nairobi, where market-driven housing provision is seen in a positive light as helping to address the formal housing need but nevertheless has promoted the economic dimension of development to the detriment of the social and the environmental components with its inevitable unsustainable outcomes.

3 Methods

To illustrate the challenges and opportunities associated with the provision of sustainable formal housing in Nairobi, this investigation made use of a case study approach that allowed for an in-depth study of a particular case in a specific area of the city. The case selected was a residential neighbourhood located in the western suburbs of the city of Nairobi. This neighbourhood, *Kileleshwa*, is part of the inner ring suburbs of the city of Nairobi and is situated only 4 km from the city's central business district (CBD) making it an ideal location in which to live given its proximity to places of work both in the city centre and in the surrounding suburbs. It is an area that has experienced rapid transformation from single-family single-story dwelling units to high rise multi-family multi-story apartment blocks over the past decade. The various emergent building typologies were documented through photography and notes made from observations done during several field site visits. The data thus derived was augmented by archival review of pertinent documents on housing and urban planning issues as well as with interviews done with the various key actors involved in the process of production and consumption of the housing units such as developers, architects, contractors, various government agencies playing a regulatory role, investors, and residents occupying the apartment units either as tenants or homeowners.

4 Results and Discussion

The understanding of sustainable development, which requires a balance of the economic, the social, and the environmental dimensions (WCED 1987), formed the basis of the analytical approach of this chapter that considered how housing is being produced and consumed in the case study context and the outcomes of these processes in relation to what would be deemed as sustainable outcomes thus forming the basis of a critique of the physical manifestation of the transformation of existing low-rise housing to high-rise housing. And since the research was largely qualitative, the perspectives of the key actors involved in the process and outcomes of transformation—the regulatory authorities, the developers and architects, and the investors and residents—also shaped the understanding of the findings.

Thus, in evaluating the processes and outcomes of housing production in the city of Nairobi, to meet a growing housing need, casting them in terms of challenges and opportunities for sustainable housing provision, illuminates more clearly some of the salient issues involved. In the discussion that follows that is the approach that is taken. The key issues concern the qualities of the infrastructure in place and the formal housing being developed.

4.1 Infrastructure

As regards infrastructure provision associated with the development of housing in the city, as illustrated in the case study area, a number of issues are apparent. This is particularly so in the case of the road network, sewage reticulation, storm water drainage, water provision, and electricity supply.

The road network in the case study area is woefully inadequate to cater for the emergent apartment blocks which rise to a height of up to thirteen floors in an area that was zoned for single family dwelling units with an allowance for, at most, four-story apartment blocks or town houses. The challenge arises from the fact that the established road network was never designed for the increased volume associated with more families residing on three quarters of an acre where only a single family used to reside. A case in point is an amalgamated site in *Kileleshwa* where three plots that previously accommodated three families in three bungalows now hold a thirteen-story apartment block in three towers designed to accommodate 110 families each with access to at least one parking space. Thus, in a very small area, less than one hectare, the number of cars have increased almost 20-fold from a possible six to more than 100, which would in effect spill onto a road network that has maintained its original structure from the inception of the neighbourhood. The exhaust from the increased cars also contributes to air pollution thus worsening the air quality of the residential neighbourhood that is part of the western suburbs of the city historically referred to as the leafy green suburb. However, given the increasing density of the area, an opportunity exists to contemplate the development of multi-modal transit including provision for a network of bike paths, pedestrian footpaths and mass transit particularly providing buses that would transit through the area and connect it to the city centre.

Similar to the issue of an overburdened road network, is the issue of the sewerage system and water provision to the neighbourhood, as well as storm water drainage.

The current sewerage system is inappropriate for apartment development. It was built with the capacity to cater for single family dwellings some of which were connected to septic tanks. However, with the emergence of apartments, connections are being made from the apartment developments to the sewer line which is now in danger of exceeding its capacity as well as adversely impacting adjacent neighbourhoods. In some instances, some developers are illegally connecting effluent from the apartments to a nearby stream thus adding to the pollution of Nairobi River into which the tributary eventually flows. The sewerage system ought to be expanded to meet the growing demand wrought by the development of apartments, and water harvesting features out to be required by the regulatory authorities as part of the approval process for apartment development.

The challenges are no different regarding water supply to the apartments. To meet the shortfall from the reticulated supply by the county government, some developers have sunk boreholes, without approval from the relevant authorities who have noted that two-thirds of the boreholes sunk in the city have not been approved.

This trend is bound to have an adverse impact on the city's aquifers as well as its plans for future water supply to the city. The boreholes, if required, should be regulated and planned to avoid excessive withdrawal of the aquifers, beyond the rate of replacement, as well as to alleviate the risk of building subsidence due to potential eventual draining of the aquifers.

The storm water drainage also suffers the challenge of being below capacity. The increased hard surface ground coverage, which is a direct result of the large building footprint of the apartments in addition to the paved driveways and parking lots has resulted in increased water run off during rainfall resulting in flooding in the lower area of the neighbourhood especially at the confluence of the two streams that drain the area. Consequently, property damage is experienced every time it rains, a situation that can be alleviated with an adequate drainage network. The storm water drainage needs to be expanded in order to cope with the increased water runoff and porous surface finishes ought to be encouraged to allow more water to naturally percolate into the ground and eventually into the water table.

With the advent of apartments in the neighbourhood, energy needs have also increased, especially in the form of electricity consumption. While the neighbourhood has a dedicated electrical power sub-station, it was not built with the capacity to handle the energy demands associated with high-rise apartment living with their increased energy needs per family. Consequently, frequent blackouts and power rationing are the norm in the apartment complexes in the neighbourhood. However, an opportunity does exist to require the adoption of alternative energy sources, such as the installation of solar panels for water heating, as part of the apartment development approval process. This would not only reduce the demand of electrical energy from the national grid but would also encourage a more sustainable approach to apartment housing development.

4.2 Housing

The demand for housing in the city is very high. Current estimates put Kenya's housing need at between 200,000 (Habitat for Humanity 2017) and 244,000 units per year with less than a quarter of these being produced annually (Thomson Reuters Foundation 2017). Formal housing provision has always lagged behind the demand for housing in Nairobi. However, a growing middle class has encouraged developers and investors alike to come up with ways in which to profitably tap into the market demand. The emergent trend has seen the densification of low rise neighbourhoods close to or easily accessible to the CBD which is dominated by government and professional jobs. Consequently, the cost of land in the inner ring suburbs especially in the more affluent suburbs to the west of the city has increased exponentially over the past decade. For example, the cost of land in the case study area has increased seven-fold over a span of a decade, 2007–2017 (Hass Consult 2017). Developers have thus argued for the need to build higher, even beyond the stipulated height limit in order to recoup their returns on investment. This is the

argument that they have adopted, and the city seems to have acquiesced to, to circumvent the stipulated height limit of four floors with an allowed ground coverage of 25–35%, and a plot ratio of 75% for the case study residential area as well as for other adjacent neighbourhoods with similar height restrictions (City Council of Nairobi 2014).

This has driven up the cost of apartments in the western suburbs to prices that are comparable to similarly sized apartments in the global North: The average mortgage in Kenya, which is approximately US$ 80,000 (Central Bank of Kenya [CBK] 2015, p. 18), barely covers half the cost of the average three-bedroom apartment in the case study area. However, this has not been without consequences. Apart from affordability issues, which limits those who can afford to own apartments to those in the higher income brackets, issues of the quality of the housing units are emerging as a singular multi-faceted challenge: From the cost per square foot hence the size of the apartment, to the construction standards hence quality of the finishes, and building design hence access to daylight and open spaces, significant challenges prevail.

The size of the apartment units on offer is significantly smaller than its equivalent single family unit. This presents a significant challenge where the average family size in Kenya is 4.4 persons (KNBS 2012)—a figure which nonetheless obscures the presence of a significant number of large households in the country. Developers use their own matrix (maximization of profit) in determining the size of the units that they engage architects to develop. The spatial requirements of the targeted residents are hardly factored in. Thus, residents are having to adapt to cramped living conditions at high cost in neighbourhoods that were historically valued for their spaciousness. The number of bedrooms such as a three-bedroom apartment, when advertised, gives the false promise of adequate space when the reality is that the three-bedroom apartment is really in actuality the equivalent of a two-bedroom house and only just. The reduced space has a direct impact on the quality of life of the residents who have to cope with reduced personal space and less privacy. Here, though, exists an opportunity for the regulatory authorities to insist on minimum standards for the various sized apartments—studio, one-bedroom, two-bedroom, three-bedroom, or four-bedroom. This would at least ensure, at the very minimum, some value for the high investment that goes into home purchase.

In a related vein, the construction standards of the emergent apartments are wanting. It is not uncommon to encounter chipping staircases in apartments under construction—bringing to question the quality of the cement used in the concrete mixture or even the professionalism of the mixing of the concrete itself—nor is it uncommon to find poor plaster work, leaking roofs and less than satisfactory plumbing in finished apartments. The government agency mandated with assuring the quality of construction is still in its nascent years and seems to lack the capacity to inspect and enforce construction standards. Further aggravating the situation is the prevalence of untrained contractors supervising unskilled labourers on construction sites. Thus, there is a real concern for the structural integrity of the apartment units being developed in the upmarket western suburbs. Unlike the

suburbs in the east of the city, the western suburbs have not experienced building collapses perhaps because the absolute minimum standards are at least being adhered to given the high cost of the apartments per square meter. However, there still exists an opportunity for higher standards of construction to be enforced to assure the sustainability of the apartment structures in the long run.

Related to the quality of construction is the issue of apartment design both in terms of form and orientation. The emergent designs do not reflect the local context. They are replicas of designs from the global North that have simply been transplanted into a context for which they were not designed nor suited. The spacing and orientation of the apartment blocks also leaves a lot to be desired. The inadequate spacing and building orientation has resulted in a majority of apartments lacking access to adequate air circulation and natural light with the result that electric lighting has to be used during the day thus adding to the energy load. Further exacerbating the situation is the prevalent use of small as well as tinted windows that contribute to inhibiting the amount of natural light admitted into the apartment interiors. The interior layouts of most apartments are also not logical in terms of the segregation of the private and more public spaces, and the external layout of apartment blocks fails to consider the need for open spaces that are necessary for communal activities and children's playing requirements. Moreover, trees that were a characteristic accompaniment of the previous bungalows that were replaced by apartments, were felled to make room for the large apartment building footprint hence resulting in the gradual development of a concrete jungle with its associated higher heat gain especially in a tropical country like Kenya. The foregoing, notwithstanding, an opportunity does exist to explore the possibility of enshrining minimum design standards especially as regards access to light, air and open space, as well as material finishes, greenery, building footprint shape, plot ratio, ground coverage, and offsets relative to property line and size.

5 Recommendations

It is inevitable that rapid population growth and urbanization in the global South, which has historically had low levels of urbanization, would generate numerous challenges. But planning as a profession is well suited to grapple with emerging and future trends, and especially as currently construed as strategic planning rather than master planning. Hence, what is perceived as a challenge in the present age could be re-considered from the point of view of an opportunity.

It is already apparent that the primarily market-driven development trends in housing production and consumption in Nairobi are resulting in numerous negative externalities. It is also not surprising that the County Government of Nairobi, the country's National Environmental Management Authority (NEMA), and the National Construction Authority (NCA)—the statutory bodies charged with the responsibility of regulating and managing the city's urban development, are struggling to stamp their authority on the emergent phenomenon. This is arguably

due to the scale and rapidity of the transformation that the urban environment is undergoing as a result of the pressure wrought by the market dynamics that are funnelling enormous amounts of funds into the real estate sector. The regulatory authorities' coping with the situation by adopting the easier option of simply charging regulatory fees as part of the approval process without providing or enforcing guidelines on how the developments should occur, is a sign of lack of preparedness for the changing economic climate. However, this is no excuse for their abdicating their role. There's is an opportunity to set the agenda for a more sustainable urban future by ensuring that each facet of development aligns with this goal.

From a sustainable urban planning perspective, a plethora of tools are at the disposal of the planners charged with the responsibility of shepherding a more sustainable future. Some of these include: planning for compact development; encouraging mixed use development, favouring transit oriented development over vehicle oriented structuring of the urban environment; developing multi-modal transit that encourages non-motorized mobility through bike paths and pedestrian walkways and foot bridges; ensuring residential neighbourhoods develop as viable, cohesive, and sustainable communities with the requisite amenities in close proximity such as schools, shopping areas, markets, public parks, entertainment facilities, health facilities, recreational facilities, places of worship, and easily accessible places of work thus encouraging development towards a people-oriented live-work-play ideal, and one that caters to the much neglected social and the environmental aspects of development as well.

Sustainable housing development could be encouraged through tried and tested strategies to overcoming the emergent externalities of housing development as currently enacted. Water catchment, the use of solar panels for water heating, sewage treatment through the use of bio-digesters, use of locally available construction materials rather than the imported ones shipped in by foreign contractors and developers, use of porous and soft surface finishes to minimize the extent of hard surfaces and encourage water percolation, should all be enshrined and enforced in the building regulations. And to assure standards are adhered to, it should be required that only trained professionals are involved in all facets of the apartment construction process—from its design to its implementation. The quality of the apartment interior and exterior design layouts and form should be subject to minimum design standards for functional spatial use. The greening of the residential neighbourhoods especially through the planting of trees and other plantings should also be a requirement of the apartment development approval process. And while the development of apartment housing goes a long way in helping meet the housing need, it is important that the diversity of housing stock be preserved. There are those who can and would prefer to live in non-apartment housing if these were made available at a level of affordability. It should thus be part of the planning strategy to preserve part of the single-family neighbourhoods not only for their historical significance but also for the variety in housing options that they would then be contributing towards.

In as much as most of the above recommendations seem normative in approach, it is a necessary direction that needs to be taken considering that developers are more likely to see all the requirements required for sustainable housing, neighbourhood and urban development as an additional cost to development rather than a value addition to their investment, given their profit motive in a highly market-driven and competitive real estate environment. Regulatory authorities are best placed to ensure that sustainable development goals are achieved as a benefit of market derived investments otherwise potentially irreversible negative consequences would become characteristic features of previously well-planned residential neighbourhoods.

6 Conclusion

This chapter has discussed some of the challenges and opportunities related to rapid transformation of housing in a fast-growing city in the global South. While it is limited in scope in focussing on a case study drawn from one country, it has nonetheless highlighted pertinent issues that would be relevant in an analysis of other cities in the global South that are experiencing a similar phenomenon of rapid formal housing transformation. The study is also limited to formal housing provision and does not address informal housing provision where even similar issues are of a different magnitude, scale, and dynamic. However, it contributes to research into formal housing, which has largely been overlooked in discourses on housing in the global South yet needs scholarly attention to provide a more balanced understanding of the reality of the dual housing situation in this context—the formal and the informal and the unique challenges and opportunities that this presents in addressing issues related to sustainability in an urban habitat.

An apartment is an expensive real estate investment both from the supply and consumption side of the market hence, ensuring its sustainability has to be front and centre on the list of priorities that the city sets for itself in ensuring that its residents are adequately housed. And when done sustainably, the quality of life of the residents is thus assured and so is the city's contribution to a sustainable and viable planet for human habitat.

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Yueqing's Healthy Future: A Case Study in Design Planning for Healthy Urbanization

Linda Powers Tomasso, Cristina Contreras Casado, Judith Rodriguez, Jie Yin and Julia Kane Africa

Abstract *Yueqing's Healthy Future* is a context-based analysis for improving urban health against a background of unprecedented regional population transition in China's mid-tier cities. This extended case study considers how China's economic ascendancy, having ignited an epidemiological transition from communicable diseases more prevalent in rural areas toward largely preventable, non-communicable diseases typical of twenty-first century urban lifestyles, can facilitate more sustainable models of future urban development. *Yueqing's Healthy Future* begins as sustainable infrastructure design within a framework of measurable standards to intentionally redress China's environmental health crisis and resulting urban health problems. Key determinates for urban livability are amply addressed: urban infrastructure design, the built environment, the incorporation of nature, quality of life, and health and wellness. Prescriptive guidance to optimize urban health and long-term sustainability in the process of urban growth and development accompanies this case study: urban climate change resilience, urban mobility, and strategies for healthier buildings. This assessment includes recom-

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mendations by a joint research team from the Harvard Graduate School of Design and the Harvard T.H. Chan School of Public Health. Although these proposals reflect actual climatic, ecological, and environmental policy conditions of Yueqing, China and thus are tailored to improve that city's sustainability profile, the recommendations may inform urban projects elsewhere with similar urban infrastructure and ecological conditions already in place.

Keywords Urban health · Sustainable infrastructure planning · Urban design Chinese cities · Sustainability metrics

1 Introduction

China, fostered the "Urban Design for Health" case study in Yueqing, a fast-growing city in Southeastern China. The Health and Places Initiative, a multi-year design-based research effort at Harvard University to improve urban health in fast-modernizing China. This initiative features the unique collaboration between the T.H. Chan School of Public Health's science-based practice of public health with the Graduate School of Design's rigorous criteria for sustainable urban infrastructure design. Actual climatic, hydrological, ecological, and development conditions drove recommendations to improve that of a large development planned on the periphery of the existing urban core. These insights are transferrable to urban development proposals with similar challenges.

1.1 Defining the Problem

Healthy urban design principles form a seamless overlay to many of China's most valued cultural sensibilities: affinity with nature, notably the natural elements of water, air, and earth; a holistic health focus from Eastern medicinal practices; personal wellness; collective physical activity; active, non-vehicular transit; and nutritive foods that allow for distinctive regional cuisines.

Yet health and environment can be double agents for social change (Davis 1997). Geography, population density, national aspirations, and a successful industrial transition have placed China in the complex space of fast developing economies that emerge from predominantly rural societies. Rapid technological advances in communications and transit have catapulted transforming societies like China's toward modernizing growth but have degraded environments in the process. Environmental pollutants have fed China's massive rise in cardiovascular disease, cancers, and chronic respiratory illness, and causal links between industry, urbanization, and construction impacting public health in Chinese cities are well-documented (Wang and Mauzeralli 2006; Matus et al. 2012).

One casualty of rapid economic transition is the "dual burden of disease" (Fig. 1). Under this paradigm, diseases of urban affluence—obesity, diabetes and inactivity—co-exist with high morbidity from widespread malnutrition, water insecurity, and poor sanitation in the underdeveloped countryside. China's Phase II to Phase III epidemiological transition means behavior-influenced causes of early death are replacing communicable diseases as prime morbidity factors (Popkin and Du 2003). China's full transition to a service economy projects manufacturing to shift to a sedentary workforce. The goal of healthy urbanism therefore, is to move economically advancing societies like China past Phase III toward prevention of degenerative diseases and delayed cardiovascular decline.

Environmental pollution exhibits a similarly bifurcated urban-rural profile (Fig. 2). Soaring levels of $PM_{2.5}$ air contaminants have rendered city air noxious and unbreathable. Industrial water and soil contamination downstream intensify challenges to rural regions confronting inadequate water and sanitation systems. China's rural-to-urban transition demonstrates how the ecological spillover from populous cities into former agricultural lands is outstripping the bounds of standard institutional governance. Additionally, where past generations disavowed individual wellbeing on behalf of national growth, today's younger, modernized urban residents reject such compromise, embracing traditional and modern practices (Fig. 3).

China's New National Plan will further test the limits of urban metabolism by resettling one percent of rural residents annually through 2020. Population densification increases demands for land, energy, food, water, and space while constraining efficient mobility, breathable air, and salutogenic housing. Status quo development ignores evidence for activity-promoting infrastructure design, healthier construction practices, low-carbon transit, and reduced CO_2 emissions to

Fig. 1 Dual burden of disease: infectious + non-communicable diseases. *Source* Figs. 1, 2, 3, and 4: Tomasso et al. (2015)

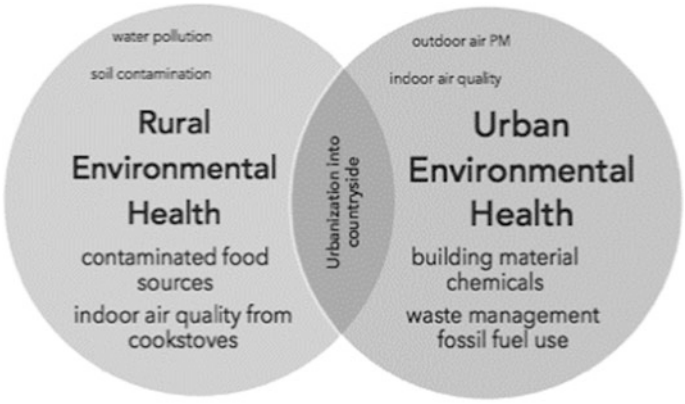

Fig. 2 Dual burden of environmental health: rural + urban pollutants. *Source* Tomasso et al. (2015)

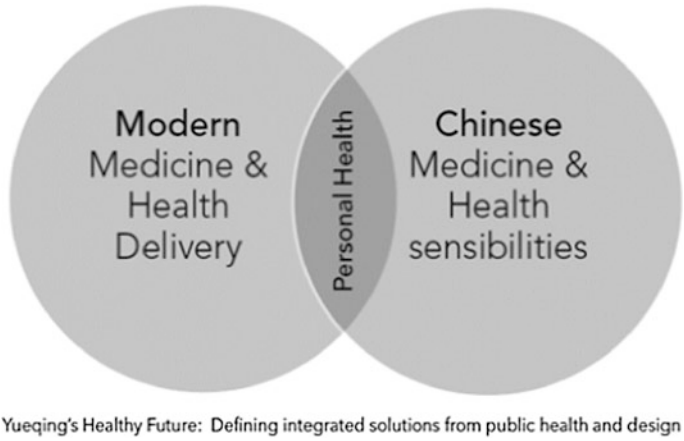

Fig. 3 Conventional + Traditional Chinese therapeutic practices + design sensibilities expand the palette of solutions. *Source* Tomasso et al. (2015)

forestall the health crises of modern metropoles. To become a "first adopter" of sustainable infrastructure design and healthy urbanization breaks from a business-as-usual (BAU) development scenario prevalent in China's regional expansion to must attenuate urban health vulnerabilities.

Recognizing the interrelationships among contributing factors encourages public health officials, urban planners, and developers to collaborate toward positive population health outcomes (Fig. 4). Leverage points like these inform our report recommendations.

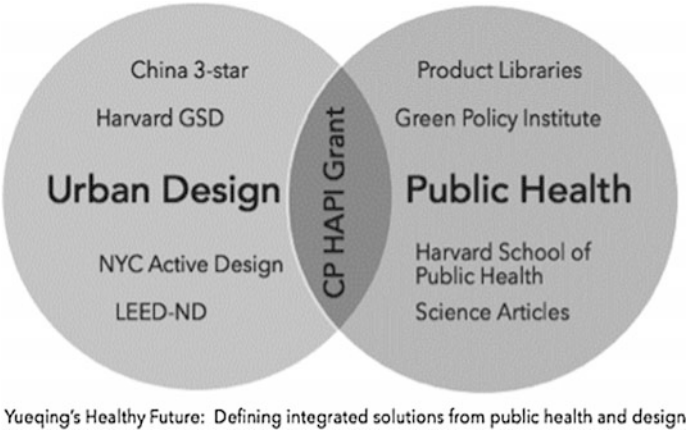

Fig. 4 Planning for Communities that are healthy, efficient and resilient. *Source* Tomasso et al. (2015)

Thus, our goals for addressing healthy urban development are to:

- Demonstrate health responsiveness as a new metric of urban sustainability
- Introduce research-based design to enhance urban development
- Draw upon state-of-the-science research on IAQ and public health
- Maintain existing environmental services by managing ecological resources
- Make health an intended urban design outcome of Envision®-inspired case studies

1.2 Synergies Between Urban Design and Public Health

Urban design for health is critical public health research that finds precedent in natural synergies between urban design and environmental sustainability. Active urban design has the potential to save energy while promoting health through movement. Design strategies that make walking or transit as attractive as private vehicle use synergistically reduce vehicles miles traveled, fuel demand and transportation emissions. Planning and regulations must similarly push cities to adopt designs and technologies that lower urban metabolism through reduced energy needs. Urban sustainability models combine higher density and income disposability with lower individual transportation and energy consumption through *planned* reductions in demand, a paradigm contrary to China's centrifugally developed newer cities.

Research on transit-health linkages has produced a codified set of five "D" variables—density, diversity, design, destination accessibility and distance to transit–under which planning of urban transportation patterns can improve public

health (Cervero and Kockelman 1997; Ewing and Cervero 2001). Population density quintessentially defines China. Diversity implies varied land use purposes. Distance to transit means the new W2 light rail line from Wenzhou to satellite cities like Yueqing. Typically connoting aesthetics, here design predisposes the urban landscape to favor intermodal transport and streetscape lay-outs consistent with Active Design principles. Design directly influence destination accessibility to the various "development clusters" named in Yueqing's Master Plan. These five "D" elements are concrete and objective, at once place-specific and adaptable to landscape-scale projects.

1.3 Methodology

Our applied assessment methodology is the Envision® rating system, a set of guidelines that holistically evaluates sustainability using various parameters to gauge project performance. This rating system rethinks infrastructure placement, design, and purpose within the social and environmental contexts of long-term project contribution to community sustainability. Credits attainable in Leadership, Quality of Life, Resource Allocation, Natural World, and Climate and Risk categories synergistically underpin sustainable urban design principles that support health and well-being (Fig. 5). Envision's application during initial project design phase allows developers to consider a priori alternative proposals that favor sustainability.

For this analysis, we overlaid insights from China's 3-Star Standard on Green Residential Area and LEED for Neighborhood Development onto Envision, cross-referencing these tools for a detailed comparative analysis that captures common urban sustainability principles within contextualized built environment norms (Fig. 6). Our recommendations were based on a March 2015 site visit to Yueqing and a close reading of internal, municipal and regional planning documents on both project and environmental impact that development poses to local ecological resources.

1.4 Project Description

Yueqing lies 15 km inland of the East China Sea and south of the Yangtze River Delta within southeastern Zhejiang Province. Topography varies between moderately elevated inland areas to hilly coastal plains that lie within marine temperate zones. A humid, subtropical monsoon climate with seasonal weather patterns dominates the coast.

Yueqing's expansion typifies the aggressive development undertaken in the early 1980s when special Economic Incentive Zones created an "urban necklace" of southeastern coastal cities dense with heavy industry. Recent government investment in public light-rail and highway infrastructure has stimulated an inflow of

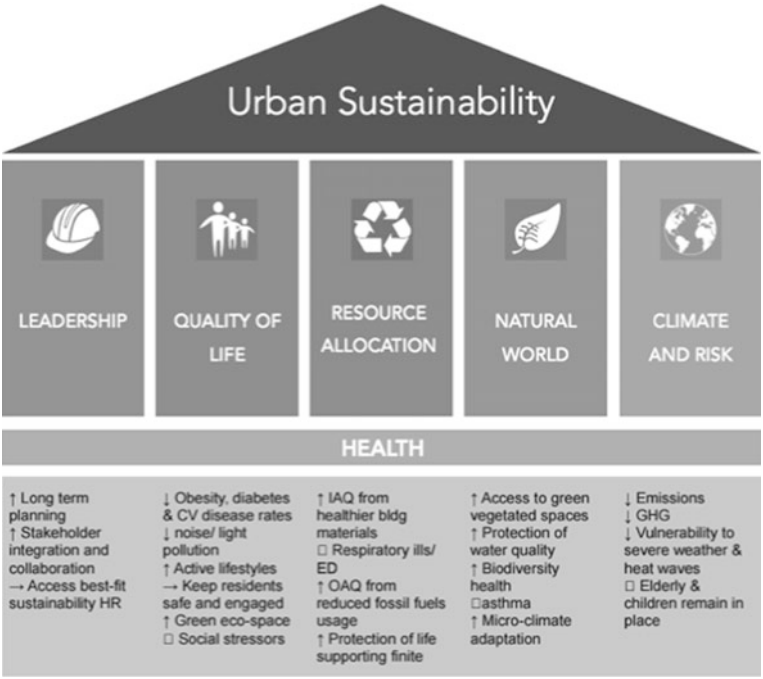

Fig. 5 The Zofnass Envision® Rating System's Five Pillars of Urban Sustainability. *Source* Rodriguez & Contreras, Harvard Graduate School of Design, Tomasso et al. (2015)

non-industrial activity into Yueqing and its regional capital, Wenzhou. Commercial centers, seasonal mountain tourism, and local amenities having strengthened the region's economic diversification through rail connectivity.

Against this background, Yueqing's Grand City enlargement projects large-scale development integrating residential, commercial office, retail, and recreational structures (119,248 m^2 total area footprint and 356,579 m^2 total floor area). Development plans forecast a 32.8% building density and a 20% open space ratio within the overall site. An EIA performed by Yueqing's Office of Environmental Protection (2014) on the proposed site highlights two sets of environmental concerns: (1) waste, dust, noise, vehicle emissions and environmental neglect during actual construction; and (2) vehicle emissions from the underground garage and on-site equipment noise post-construction.

Yueqing now confronts a once-in-a-generation opportunity to redefine sustainable urban development if purposefully designed for improving current health outcomes. Local leadership by City Government, China Construction Company, and private developers must understand this potential.

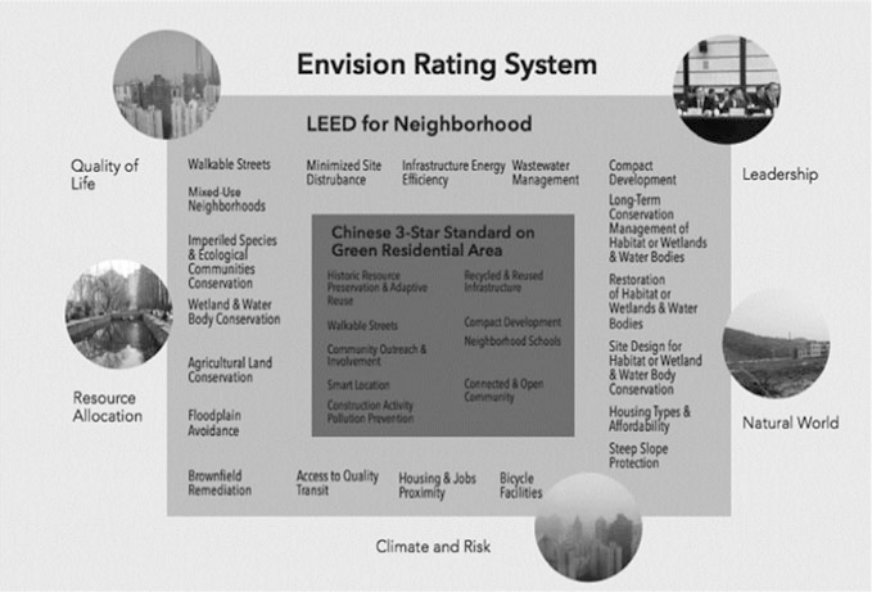

Fig. 6 Shared Synergies of Rating Systems: China's 3-Star, US Green Building Council's LEED for Neighborhood Design, and Harvard Zofnass Envision® Rating System. *Source* Rodriguez (2015)

2 Leadership Category

A participatory approach to realizing "a more livable and sustainable city" requires strong leaders fully committed to long-term outcomes. Leadership must also undertake the short-term goals of moving away from BAU models and incentivising collaboration between different actors involved in strategically planning for city development. China's BAU urbanization is challenged by laggard "vision," "planning," and "implementation" processes (Rogers and Srinivasan 2007). This is not an isolated problem China faces but rather is common to most cities that experienced explosive growth subsidized by cheap energy in the latter twentieth century. To change the existing paradigm, project development must recast these three challenges to its benefit:

(1) **Vision**: Economic growth has driven China's urban development absent any rationale for creating livable cities. The quest for economic development has undermined social development and environmental protection to create cities of inferior "livability." A strong leadership foundation must focus directly on the end goal of "creating livable cities." The wide variety of actors potentially contributing to this vision underscores the importance of promoting transparent governance frameworks that accommodates different infrastructure systems to work in integrated fashion.

The multidimensionality of factors driving sustainability demands meaningful stakeholder engagement processes and early consensus-building to help the project team. This pre-planning process allows engaged parties to contextualize new and unfamiliar concepts within the existent infrastructure that may prove necessary to achieve the new urban paradigm of livable–and not just developed–cities. Broadening the leadership base to achieve early consensus increases the odds of formulating a successful sustainability vision. Vision regards not just operational perspectives but the reality that stakeholders from different cultural backgrounds perceive ethics and sustainability differently (Rawwas et al. 2007). These facts merit consideration when defining day-to-day operational goals.

(2) **Planning**: Fifty-six percent of Chinese lived in urban areas in 2015, a level increasing annually through planned and organic urbanization (National Bureau of Statistics of China 2015). While megacities are magnets for rural migrants, Tier 3 medium-sized cities have experienced the most radical growth (Asian Development Bank 2013). These unanticipated urban growth patterns have meant that population increase and measured per capita income rise determine demand for urban infrastructure, not vice versa. Furthermore, urbanization in China's fastest growing cities has occurred without pause to assess either quality of development or quality of management overseeing development.
China's fast-track build-out contrasts with that in other countries, where a more gradual urbanization matured across a century or more via protracted population shifts. Chinese cities, in contrast, have grown at a rate where governance lags behind endlessly evolving infrastructure needs. Consequently, cities have developed without municipal managerial capability, planning for targeted growth, or efficient land usage. Capacity-building in sustainable project planning and stakeholder engagement should anchor China's fast-paced urban development if cities hope to achieve livability goals.

(3) **Implementation**: A city will only be as sustainable as the planning process used to predict its development outcome. Implementation of a sustainability strategy requires an integrated approach aligned with the original project vision. Adopting a long-term view of project development will necessarily improve sustainability implementation. Once implemented, urban sustainability should be assessed both temporally (at multiple points over time) and spatially (ex. urban growth measured as unit of land conversion by population density) (Rogers and Srinavasan 2007). An institutional culture, whether pre-existing or created ad hoc, should reflect regulatory compliance and enforcement, institutional strengthening both normative and juridical, and a trained municipal management class (*Ibid.*). Developing this culture occurs over time. A deep understanding of financial mechanisms, political agendas and regulatory environments is key to navigate systems and influence change towards a sustainable future. Successfully implementing a sustainability strategy requires not just compliance with "vision" and "planning" but also the integration of active protocols that help monitor compliance and forward progress to achieve long-lasting change.

3 Quality of Life Category

Active, age-friendly, and healthy communities should be the outcomes intentional urban design to improve residents' quality of life.

3.1 Spatial Integration and Urban Integrity

With only 22.7% of developed areas dedicated to green space, Yueqing trails all cities in Wenzhou district for available parkland (Wenzhou Statistical Yearbook 2012). In fact, Yueqing residents expressed only "neutral" satisfaction with local green space on a 2014 city-wide survey conducted by the Harvard Chan School of Public Health (CHGE 2014). Different populations have different programming needs. Adults seeking space to gather or recreate may prefer more formal structures, safety features, and public art, while children gravitate toward naturalistic parks due to varied landscape features and biodiversity. Communal plazas and parks provide health benefits through promotion of physical activity, stress mitigation, noise reduction, and support for social networks, especially for families with young children. Better design of green space can promote greater overall fitness, gross motor development (Balseviciene et al. 2014), while replacing "screen time" (Dadvand et al. 2014).

Several experimental studies suggest that visual exposure to green spaces can stimulate recovery from stress and mental fatigue, reduce blood pressure, and improve immunological function (Ulrich et al. 1991). Epidemiological studies conducted in Europe identified exposure to green space as predictive of elevated birth weight (Grazuleviciene et al. 2014), improved working memory among students (Nieuwenhuijsen et al. 2014), and lower risk of cardiovascular morbidity (Grazuleviciene et al. 2015).

Additionally, obesity is an emerging public health crisis in cities like Yueqing exacerbated by physical inactivity and unhealthy diets. Physical activity plays a fundamental physiological role in chronic disease prevention for type-2 diabetes (95% of diabetes cases), CVD, hypertension, and more prevalent cancers (WHO 2009). What's more, According to Yueqing's People's Political Consultative Conference, its rapidly increasing elderly population accounts for 14.4% of demographics and is rising annually by 4%. Chronic diseases and mental illnesses among older adults have become prominent social problems. To address these issues based on the existing evidence, specific actions are recommended to foster inclusiveness:

- Incorporate health consideration for all ages into planning processes.
- Increase urban green spaces and public parks for diverse activity.
- Design a network of green spaces to conserve biodiversity, increase accessibility to nature and buffer traffic noise.
- Promote inclusionary zoning for suitable, affordable housing to ensure easy access to services.
- Provide safe and diverse mobility options across age groups.

3.2 Sustainable Mobility and Health

Sustainable mobility tops China's urban health challenges, as private vehicle ownership and air pollution rise in tandem. Traffic directly impacts urban health through the incidence and severity of air pollution-induced health hazards. Car use contributes notably to sedentarism that increases risk of all-cause mortality, doubles the risk of CVD, diabetes and obesity, and adds to long-term disability risks (World Health Organization 2009). Planning authorities recognize that continual road expansion to accommodate increasing traffic is untenable for urban mobility and unhealthy for all residents, non-motorists and motorists alike.

In China's major cities, motor vehicle pollutants account for high percentages of carbon monoxide (CO), hydrocarbons, nitrogen oxides (NO_x), and fine airborne particles, all found in higher concentrations near major roads (US EPA 2015). The harmful health effects associated with proximity to roads include asthma, CVD, reduced lung function, impaired childhood lung development, preterm and low-birthweight infants, childhood leukemia, and premature death (WHO 2009). Vehicle noise also is linked to auditory and non-auditory health effects associated with roadway exposure. Many of Yueqing's new development sites increase residential exposures to air pollution due to locations adjacent to heavily trafficked roadways, sub-distributor roads and high-speed expressways.

The Yueqing Planning Department will accommodate the estimated 20% traffic growth rate in the Wenzhou-Taizhou corridor by adding highway lanes but also incorporating new high speed rail stations and light rail infrastructure (Yueqing Planning Department 2009). Expanding connectivity to the 250 km/h Yongwen high-speed railway will pivotally help Yueqing stimulate market integration with larger regional cities like Wenzhou, Taizhou and Shanghai (Zheng and Kahn 2013).

The future of Yueqing's sustainable mobility and health lies in realizing these actions:

- Improve the public realm supporting physically active lifestyles, and encourage car free environments by reducing car use, traffic, and parking in new developments.
- Plan and design air pollution mitigation strategies for areas abutting major roads.
- Design connected and livable communities by encouraging pedestrian and bicycling activity along corridors connecting to public transit.
- Prioritize transit-oriented development by concentrating development along transit and high-speed rail networks, as well as enhancing access and connectivity.

4 Resource Allocation Category

As global population pushes past seven billion, sustainable development strategies become vital to ensure efficient resource allocation. This holds true worldwide but especially in China, where population is expected to peak at 1.4 billion by 2020 (Hoornweg and Bhada-Tata 2012). Appropriate resource use within this case study is dedicated to three subtopics (i) energy sustainability; (ii) waste management and (iii) healthy building materials.

4.1 Energy Sustainability

Yueqing is typical of Chinese cities in its 99% reliance on a fossil-based energy structure, mostly from coal-fired electrical plants. Renewable energy from wind, solar, and biomass remains incipient. Yueqing's urban residents are limited in adopting cleaner fuels: only 1% can access natural gas, while 36% can utilize liquefied petroleum gas (Wenzhou Statistical Yearbook 2012). Of Wenzhou district's eight cities, Yueqing consumes the most energy, with total energy consumption accounting for over half of entire district energy use. Yueqing's energy intensity is nearly four times the average district level (Wenzhou Statistical Yearbook 2012). Yueqing's energy production capacity is insufficient to support long-term demand growth based on traditional energy-intensive patterns of economic development. The large gap toward achieving energy efficiency is particularly salient in China's building sector.

Moreover, in China's current urban planning system, spatial and energy planning analyses are conducted separately, with the former always taking precedence. Inappropriate land-use patterns and spatial maldistribution have induced high energy demands, heavy dependency on external energy supplies, and environmental deterioration. In order to better understand the connections among energy, urban planning and public health, our framework considers how energy consumption affects population health and how urban planning can promote energy sustainability (Fig. 7).

Achieving the goal of energy sustainability requires the joint efforts of various areas of expertise. Specifically, focusing on the effects of reduced energy usage on public health that can stem from changes to urban planning. The definition of energy sustainability dictates energy efficiency and renewable energy be its twin pillars (Prindle 2007). Our original matrix connects three rules of Trias Energetica to the three major subcategories of urban planning: urban design, land-use planning and transportation, and infrastructure planning (Table 1).

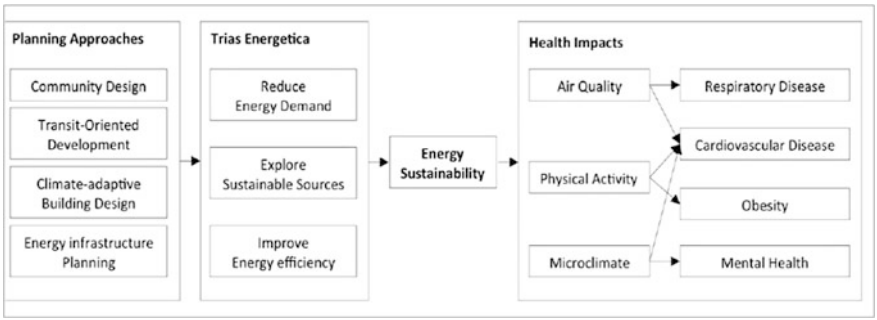

Fig. 7 Analysis framework for energy sustainability, urban planning and public health. *Note*: Trias Energetica is a three-step strategy to create an energy efficient design, which was developed by Kees Duijvestein from the Delft University of Technology in 1979. *Source* Yin, Harvard Chan School of Public Health (2015)

Table 1 Strategies for achieving energy sustainability through urban planning

	Reduce unnecessary energy demand	Explore sustainable energy sources	Improve fossil energy efficiency
Urban design	• Connected and open community • Complete street • Wetland and water body conservation • Providing public green spaces and exercise facilities • Using permeable pavement • Green roof and vertical planting	• Building orientation • Building integrated photovoltaic • Passive solar heating • Geothermal heating	
Land-use planning and transportation	• Promoting public transit • Compact development • Mixed-use neighborhood • Housing and job proximity		
Infrastructure planning			• Switching to nature gas • Combined heat and power (CHP) units • Energy production and consumption proximity

Source Yin, Harvard Chan School of Public Health available at https://www.hsph.harvard.edu/

4.2 Waste Management

The scientific literature shows that waste production follows several parameters, notably population density and income, which closely influences consumption habits. As GDP per capita increases, so does solid waste production, with consumption and nutrition patterns the primary drivers of growth (Hoornweg and Bhada-Tata 2012). China is now the largest generator of waste in the world. The World Bank speculates that by 2030 China will likely produce double the U.S. volume of municipal solid waste (*Ibid*). The ongoing construction boom and rising consumerism in China are key challenges that add complexity to growth trends in waste endemic to high population densification. A multidimensional waste management strategy is needed to minimize material inputs, maximize resources reuse and limit discharge. These strategies begin with (i) appropriate waste reporting as an incentive for Source Reduction and Reuse following the example of countries like Singapore; (ii) formal and informal recycling programs; and (iii) food composting as common practice.

Our context-based analysis suggests even broader waste management challenges exist at the local level. The Environmental Impact Assessment (EIA) conducted for this site identified various challenges regarding solid waste—including construction waste and long-term food waste—but also wastewater, effluent waste and gaseous waste, both residential and commercial (Yueqing Central Government 2014). Of China's total municipal solid waste volume, roughly 50–70% is food waste (Liu 2014; Tai et al. 2011) eventually disposed of mostly through incineration or landfill. Opportunities to diversify waste management strategies can both improve sanitation and optimize resource use while reducing GHG emissions and environmental impacts to water and soil.

4.3 Use of Healthy Materials

By most estimates, urban residents spend between 90–95% of their lives indoors (US EPA 2013). The impact of long-term indoor air quality on occupant health is among the most direct yet least predictable mechanisms by which urbanization will permanently affect the physiology of China's next generation. The chemical persistence of active ingredients used to formulate many building materials and indoor consumer products severely impacts human health and long-term development (Grandjean and Landrigan 2014). Health impacts are greatest to children whose higher proportion of body fat accumulates toxins more readily than adult cells. Both the building system's capacity for healthy air exchange and the off-gassing of building and decorative materials into the indoor environment influence the quality of the air respired. Unhealthy chemicals pervade basic building materials in China: flame retardants, volatile organic compounds (VOCs) and semi-VOCs, formaldehyde, phthalates, plasticizers, pesticides, and PVC piping are most common. Occupant health, comfort, and productivity must be weighed against the cost, effectiveness, and durability of materials specified for building construction and decoration.

5 Natural Environment Category

Industrialization has displaced the historically central role of nature in the China. Provincial and municipal governments struggle to mitigate degraded "natural commons" (air, water, soil) which threaten personal and communal health and well-being. Remediation requires systematic change in the way the built environment interacts with nature that embraces limits to growth, pollution control, and conservation as foundational assumptions. Chinese cities face growing water insecurity due to climate change, demand from rising populations and contamination. Although government mapping of ecological corridors, hydrological systems, and long-range land use is notionally employed for development, the reality is that local municipalities are the land-lease agents whose incentives may not be fully aligned with more holistic, regional planning perspectives.

5.1 Sustainable Water Use and Management

Potable water shortages thwart urban development in Yueqing and throughout China. Fresh water is being used or contaminated at rates that exceed replenishment, and climate change portends accentuated shortfalls. Contaminants that pose a threat to fresh water supply include sewage, agricultural chemicals, and manufacturing wastes. Industrial waste discharge from facilities located on rivers is the largest contributor to poor water quality across China. Current wastewater treatment in greater Yueqing is limited, occurring through concentrated processing and dispersed processing. Untreated water is regularly discharged directly into the Ou River where dilution is subject to tidal ebb and flow. Nearby municipal pipes backflow regularly.

Yueqing imports water from other regions of China. The Yueqing 2005–2025 Master Plan concedes that siting of new developments occurs in areas with insufficient water to meet long-term demand. A review of the Master Plan shows infrastructure goals for the provision and treatment of water to include: (1) a comprehensive system of distributed water intake and post-treatment disposal; (2) 100% water supply coverage; and (3) improved wastewater treatment and recycling targets. Such ambitious goals must combine water harvesting, treatment, conservation, and general use reduction per capita to compensate for a rising consumer base. The Master Plan further highlights need for a water use monitoring system for the industrial, agricultural, domestic, and service sectors. High demand for treated water in industrial settings can only be offset with more efficient water use for agriculture, domestic and service sectors. The following water conservation actions are advised:

- Encourage water savings through 100% coverage of water-saving appliances in new construction and incentivize appliance replacement in older buildings.

- Implement total water management in new developments and monitor ongoing use.
- Manage stormwater by setting capacity targets and minimizing runoff.

5.2 Biophilic Design

Biophilic and biomimetic design techniques use synergies between nature and the built environment to create more efficient, sustainable and healthy communities. The term "Biophilia," understood as "the innate tendency [in human beings] to focus on life and lifelike processes" (Wilson 1984), has evolved into a design practice that relies on the use of nature and natural design cues to support well-being. A biophilic city is one that "puts nature first in its design, planning, and management; it recognizes the essential need for daily human contact with nature" (Beatley 2010) at regional, municipal, building and resident-specific scales, ideally in a way which mimics the richness and interconnected vibrancy of an ecosystem.

Contact with nature is an essential component of vital urbanism, and green spaces are linked to benefits ranging from higher test scores and real estate values to improved psychological and physiological health outcomes. The design solutions offered by ecologically responsive techniques can also inform infrastructure, whether through adapting an existing ecological function (wastewater treatment wetlands), engineering ecological communities (shellfish banks for water filtration and coastal protection), or the creation of entirely new synergies between cities and biomes (new microclimates and conservation corridors through savvy planning). In Yueqing, erosion from improvident building practices, careless construction waste disposal, wanton destruction of wetlands, aggressive extension of coastal aquaculture pose man-made environmental threats. A more respectful and balanced relationship with site hydrology and geology would preserve some remnant coastal and inland wetland ecosystems, avoid new construction on cliffs and slopes, and erosion control through tactical use of excavated soils. In a natural world undergoing profound and accelerating changes, efforts to learn from nature's resilience, imitate her efficiencies, and honor her sovereignty have never been more critical.

6 Climate and Risk Category

Urban development triggers an upward spiral of increased energy use and emitted carbon, a coupling that contributes to changing climate and risk-heightening weather patterns. American environmental campaigner Hazel Henderson's widely quoted adage, "think globally, act locally," perfectly frames this exploration of climate change and resilience strategies. To reduce vulnerabilities, an integrated approach between urban planning and early risk identification will be required.

6.1 Air Pollution and Emission Impact

China's infamous "airpocalypses" hang heavy with toxic particulate matter (PM) size 2.5 microns or smaller. $PM_{2.5}$ is strongly associated with increased cardiopulmonary mortality and morbidity, with negative health effects manifesting within hours of exposure. China experiences 1.6 million deaths annually from inhalation of polluted air, equal to 22 million disability-adjusted life years (DALYs), a measure of work-year productivity loss (Rohde and Muller 2015). $PM_{2.5}$ can penetrate indoors, transmitting auto exhaust and industrial product emissions into confined spaces. Time spent indoors in China exceeds global averages, making $PM_{2.5}$ infiltration of interior environments an acute health concern.

Air filtering technologies, more transparent IAQ monitoring through sensors, and green science form the tripod of pathways to reducing human health impacts from urban interiors. Innovative air purifying and filtering technologies are being commercialized from research stages to block the permeability of polluted outdoor air into indoor environments. The use of air purifiers to remove $PM_{2.5}$ from indoor environments has been shown to lower the risk factors associated with cardiopulmonary disease among young, healthy adults; to reduce incidents of cardiovascular arrest, and to initiate cardiopulmonary benefits shortly after system activation (Chen et al. 2015).

Rising awareness of IAQ risk has sensitized many Chinese into monitoring their environments for harmful VOC, humidity and CO_2 levels. Benign indoor air is considered a business opportunity in China. RESET™ originated in China as a content-based indoor air quality monitoring system that since developed into the world's first building standard to assess the health performance of indoor spaces in real-time. The Living Building Challenge's partnership with RESET is now active in 24 countries, taking IAQ measurement standards from China to the world.

6.2 Land Use and Resiliency

The expansion of cities in China has diminished responsible land use and imperiled the vital ecological services they support. Coastal land reclamation and development patterns, conversion of agricultural land to industrial uses, and the loss wetland habitats has further diminished the community's ability to withstand shifts in storm and flood severity. A debris flow occurring in Wenzhou City, Zhejiang Province in 2004 caused an estimated socio-economic costs of US$ 2.5 billion.

In addition to ecological service provisioning, ecological zones often contain water bodies, forests, native biodiversity, and local landscape features such as migratory corridors that connect with broader habitat needs. Local offices of environmental protection invest in understanding what ecological services regional landscapes provision. The Zhejiang Planning Institute mapped out a long-range land use plan for Yueqing in 2005 that designated "ecological spaces" and

"ecological greenlands" intended for non-development. Our review of the EIA developed by the Yueqing Government for the proposed development noted the risks of flood and debris flow as major vulnerabilities since the site transected a designated ecological zone.

Risk-reducing and resilience-building strategies proposed with urban expansion prioritize: (i) the creation of a protection buffer through the use of green infrastructure. For instance, a standard 10-m setback for on-site structures should be broadened to reflect river width and elevation. (ii) an increase in permeable over impermeable surfaces that integrates rooftops, sidewalks, pavement, multi-level and ground-level parking lots into a composite surface target.

7 Recommendations

7.1 Leadership

The future livability of cities like Yueqing rests in seeing health as a new metric of urban sustainability. Delivery of healthier built environments can differentiate urban development in China to universal benefit, despite untested levels of modern growth. Sustainability and health connect to market demand for China's emerging middle class and, if done sincerely, are values proving to be a prioritized by next-generation consumers. Developers, planners, and civic leaders who on-board early can comfortably push forward the symbiotic benefits of healthy urban design.

7.2 Quality of Life

Integration of spatial design and transportation planning is essential for improving urban residents' quality of life. Central Government investments in transit infrastructure demands municipal follow-through via Transit-Oriented-Development that creates networked livable communities. Design of "last-mile" walking and biking facilities should connect public transit with workplaces and residential areas to encourage daily and physical activity. Reduced car use and parking in new developments offers safety benefits for children and seniors. With aging a global concern, design of age-friendly communities that integrate suitable and affordable housing, diverse mobility options and safe public spaces supports the health and well-being of all age groups.

7.3 Resource Allocation

Cities like Yueqing dependent on fossilized energy can still initiate and enforce higher standards of energy efficiency in the design of individual buildings, off-grid renewables, and spatial lay-out of new development. Energy conscious urban design connects and opens communities through high-efficiency infrastructure and low-carbon transit alternatives. Waste management includes source reduction, recycling and composting, energy recovery, and minimal landfill disposal. Procurement of healthy building materials regenerates building interiors. Lowering water footprints entails monitoring overall water use in commercial and residential development based on life cycle costing that couples low-flow fixtures with reduced usage payments.

7.4 Natural World

The use of nature and natural design cues to improve human health, environmental quality and infrastructure performance in urban settings is critical. Protecting ecological functions and natural corridors absorbs many impacts of frenetic urbanism through the provision of outright refuge (habitat, microclimates), psychological respite (from urban stressors), or contaminant metabolization (through phytoremediation). In Yueqing City, where water shortages rank among the most pressing concerns, maintaining eco-connectivity of new development to surrounding ecological zones is key to protecting the fragile site hydrology–from flooding, contamination, and exploitation.

7.5 Climate and Risk

A comprehensive flood protection plan can offset risk that Yueqing's low lying and reclaimed areas as well as geography pose. Strategies identified include expanding coastal defense infrastructure, preserving wetlands, and wider pervious pavement use. Implementing agencies will be most receptive of multipurpose solutions that simultaneously mitigate different flood impacts rather than singly-focused tools. As example, green roof design can co-deliver stormwater management strategy with outdoor air quality improvements to greater cost-effectiveness, capturing capture atmospheric CO_2 while reducing airborne pollutants like smog, dust, aerosols, and nitrogen compounds before wafting indoors. Three recommended market transformations to reduce indoor chemical pollutants–transparency, labeling, and green science rather than municipal governance.

8 Conclusions

Cities are becoming increasingly complex systems interacting together where social needs, environmental requirements, political influence and economic drivers jointly influence overall project outcomes. "As complex systems, cities become more fragile as the economy grows more powerful" (Chen and Pan 2015). The feasibility of implementing the proposed recommendations for healthier urban development at local levels in China hinges on attitudinal, actionable changes recast to be advantageous rather than bureaucratically burdensome. Only then will healthy sustainable cities become an value proposition to invested stakeholders.

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Part VII
Energy Security, Access and Efficiency

Greening of Greek Islands: Community Wind Approach at Skyros Island

Constantina Skanavis and Aristea Kounani

Abstract On account of the spreading unease regarding environmental issues such as climate change, many governments are subsidizing sustainable cities or smart eco-cities as a matter of policy. To attain a sustainable energy supply, solar and wind energy will likely provide the main renewable contributions to the developing requirements. As energy is one of the principal and primal imposing challenges confronting the society today, European countries, like Greece, have made higher pledges to affiliate larger share of renewable energy in their portfolio of energy sources, in order to countenance wider sustainable development and diminish their greenhouse gas emissions as well. Communities often show, adequate to mighty, supportive attitudes to the pursuance of renewable energy. Notwithstanding that the public customarily possesses positive attitudes towards wind energy, proposals for the installation of new wind farms are regularly met with potent rebuff. Greening Greek Cities is a considerable environmental challenge for policy makers, as they have to pursue urban development through initiatives that seek to reduce greenhouse gas emissions, and increase resource efficiency, while they are called to steer their economies out of the financial crisis. Greening Greek Islands could play a significant role in sustainability implementation as a strategy in Greece. The aim of the present paper is to examine how the attitudes to wind energy of the inhabitants of an Aegean island, could be affected by the community ownership of the wind. The Island of Skyros was chosen as the region where a giant wind farm investment was being proposed to occur, but after the opposition of the inhabitants the installation was postponed. Also, this survey assesses whether or not the community wind power increases residents' acceptance in small-scale wind farms, as a solution to the island's energy sufficiency and the broadly encouragement of

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sustainability. The attitudes and opinions of locals as well as their perception on politics, sustainable policy and energy policies' issues are being analyzed.

Keywords Greening greek islands · Community wind energy · Wind energy Skyros island · Greece

1 Introduction

During the past decades, the incessantly augmentation of human-induced environmental degradation has led the efforts to a sustainable world. So, numerous countries worldwide have dedicated to put into practice the integrated and universal vision of the Agenda for Sustainable Development (SD).

Global apprehensions, such as climate change, global warming, energy security, public health, have made sustainability an imperative necessity (Franzitta et al. 2016).

The direction taken by urban development over the imminent decades will play a fundamental role in the trajectory of worldwide greenhouse gas emissions and natural resource depletion. In response to this, worldwide, a few companies and government bodies have initiated to explore the construction of "sustainable cities" or "ecocities"or "smart cities", which must facilitate people to prosper in harmony with nature and succeed sustainable development. The expansion of sustainable cities nominates the concise comprehension of multiplicative interactions between environmental, economic, political and socio-cultural factors grounded on ecological doctrines. Cities, towns and villages are obliged to enhance the health and quality of life of their dwellers, while at the same time they retain the ecosystems on which they are contingent (Alusi et al. 2011).

Simultaneously, today's ceaselessly cumulative menace of human-induced climate change and the fluctuating world oil markets as well, have made non-fossil fuel sources of energy more imperative (Swofford and Slattery 2010; de Vries et al. 2007). Tactics to limit overall energy spending and to boost energy efficiency, as well as to enhance the use of renewable energy, are widely debated to reach this goal (Musall and Kuik 2011).

The aim of the present survey is to examine the conduct of the inhabitants of a small island, like Skyros, towards wind energy and how it could be affected by community ownership. Moreover, the paper assesses whether or not the community wind power augments residents' acceptance in small- scale wind farms, as a manner to put into effect sustainability at the island, as well as a solution to the energy sufficiency of the island. The attitudes and viewpoints of locals, the effects of politics and energy policies on their perceptions are being analyzed. Skyros Island is a small and isolated island, well known for its state of art electrical company substation and it has attracted serious publicity due to proposals for an extremely high number of wind turbines installations, creating a series of environmental consequences. This specific island was selected to be the research area because it

was of significant interest and challenging for someone to investigate the reasons that have urged the inhabitants of an island, which has already adopted sustainable management tactics like its award winning sustainable port management, to be opposed to the installation of a wind farm in their region, and consequently to the island's greening.

2 Greening Cities

Cities are the considerable consumers of the world's energy generation (60–80%), and with the urban population of the developing world projected to outspread more than 5 billion people by 2050, schemes about how to conglomerate urbanization and sustainability are of vital and instant importance. Cities can also be catalysts for environmental policy solutions. Thus, the way they are designed, managed and used have to shift substantially based on demands created by a developing awareness of a menace to the sustainability of the planet's natural environment (Alusi et al. 2011).

Under the proverb "think globally, act locally", city level sustainability analyses have proliferated over the past decades. Numerous city networks have emerged, primarily focusing on efficient and renewable energy carriers as well as climate resilience, recycling and resource management, and sustainable mobility (Baabou et al. 2017).

Therefore, the renewables will be able to upsurge their role to gratify the energy needs of a country, principally in the small islands of the Mediterranean Sea. In fact, these islands are nowadays "fossil- fuel based", which among other things are procured from other usually geopolitically erratic countries and constitute an unsustainable model (Franzitta et al. 2016).

3 Greening Islands

Small islands, wide-reaching, are progressively shifting towards sustainability as a development strategy. Owing to their fragile environment and the neediness to maintain their natural resources, islands are natural labs for climate change adaptation and integrated techniques concerning energy, water, waste etc. Sustainable cities on islands assuredly subscribe to global. Governments and developers around the globe are exploiting the avails of island spatiality to promote urban sustainability. Island spatiality presents benefits for selling smart eco-cities as role patterns of sustainable novelty: easiness of creating value, easiness of gauging sustainability, and ease of communicating successfulness (Grydehoj and Kelman 2016). Islands' confined expanse inclines to patronize integrated approaches, by which, customarily; power generation from renewable sources could be combined with electric mobility or desalination. For instance, investment in desalination prompts water saving by

ameliorating water distribution networks and emboldening effectual management of water resources. Moreover, regarding transportation, it is more effortless to adopt electro-mobility because of the limited distances, while the advantages generated from the protection of vulnerable environments and parsimony on fuel expenditures are multiplied, compared with other areas. Certainly these benefits further proliferate if accompanied by renewable power generation. Islands have potent reasons for being self-reliant, capable of demonstrating in the short term the benefits of a transition to electrified transport and renewable power generation (REW 2015).

As the power requirement of several islands is projected to increase promptly over the forthcoming decades, renewable energy sources could contribute to a self-sufficient, economic and sustainable power supply, chiefly on island systems, where the installation of extensive fossil-fired power plants is not convenient (Stich et al. 2016).

4 Implementing of SD Through Energy Policy

Measures to limit overall energy consumption and to intensify energy efficiency, as well as to augment the use of renewable energy, are widely debated to attain the goals of SD (Musall and Kuik 2011). Throughout these years, renewable energy sources (RES) have amplified their role in the generation of electrical energy in industrialized countries, principally in Europe. The initiation of innovative energy policies indeed restrict the use of exogenous fossil fuels (such as oil and coal), which involve the emissions of numerous pollutants, and especially greenhouse gases (GHG) (Franzitta et al. 2016). Wind power is recognized as significant energy resource throughout the world, and wind energy as one of the most environmentally benign sources of electricity generation (Warren et al. 2005; Brittan Jr. 2002). Wind energy evolving has increased considerably over the latter decade, owing to anxieties toward climate change, energy security, the rising cost of fossil fuels, and economic investments (Swofford and Slattery 2010; Bolinger and Wiser 2009).

The European Union (EU) is making progressively greater obligation to limit greenhouse gasses by espousing greater quota of renewable energy. Queries though the determinants that influence the public's acceptance in such renewable plants investments are becoming of significant importance (Dimitropoulos and Kontoleon 2009). Although public support for such measures is high on an abstract level, the situation in the local context is frequently contrasting (Musall and Kuik 2011). To build a sustainable society being based on renewable energy sources is a lengthy process that can last several years or even decades (Maruyama et al. 2007).

In the eighties, once the policy programs commenced, social acceptance has widely been mistreated, as a part of renewable energy technology execution. Energy companies, authorities, and private local investors opined that implementation was not a problem, because the first surveys on the public acceptance of renewables, specifically in wind power, publicized very high levels of support for the technology (Wustenhagen et al. 2007).

In 1984, Carlman was the first that defined the issue of social acceptance for wind power, while instantaneously went beyond the mere inquiry of public perception. According to her standpoint, positioning wind turbines was "also a matter of public, political, and regulatory acceptance", and in the sequel she conducted a survey on the acceptance of wind power among decision makers. Soon, in the eighties, other academics joined her in defining and analyzing the problematic issues for implementation (Wustenhagen et al. 2007; Bosley Bosley 1988; Thayer 1988; Wolsink 1987). Globally, exertions to advocate constructive renewable energy transitions are progressively accentuating the importance of cooperation with local societies (Hindmarsh and Matthews 2008; Devine- Wright 2005; Lund 2000). This reverberates the expansive credence that community outreach and involvement practices play a vital role in earning the public reliance substantial to help make renewable energy developments feasible and socially acceptable (Bristow et al. 2012; Evans et al. 2011; Jobert et al. 2007; Bolinger 2005).

Some draftsmen and policy framer of wind power consider that citizens' opposition is based on misconceptions. Consequently, according to their hypothesis, people oppose because of ignorance or misinformation; or that opposition to wind power is deviant (Aitken 2010). Having this in mind, public response toward wind farm developments could take a turn for the positive, if an alteration in development models toward community ownership occurred (Skanavis et al. 2014; Pasqualetti et al. 2002).

4.1 Increasing Public Acceptance

4.1.1 Community Participation

Since at least the 1960s, community engagement—or public participation—in decision making process has been an issue of substantial importance, since it always have led into socially acceptable, and hence sustainable upshots, and have given significant legality to those decisions (Aitken et al. 2016; Brownill and Parker 2010; Chilvers 2008; Buchy and Hoverman 2000).

4.1.2 Consultation

Consultation targets to converge insights into the opinions, attitudes or knowledge of members of the community in order to familiarize of pertinent decisions and it will be best established and most efficacious once it is perceived to be meaningful (Aitken et al. 2016).

4.1.3 Empowerment

Approaches to community engagement, comprise the transference of power to contributors and the creation of benefits for participants and broader communion. This can be succeeded through community-led formulas of engagement, partnership approaches, or approaches which bring together community members in ways that build relationships, design the procedure themselves and determine objectives, topics of significance and scope (Aitken et al. 2016; INVOLVE 2005; Rowe and Frewer 2005; Wilcox 1994).

4.1.4 Community Wind Ownership

Community wind power has both a business aspect and an environmental movement aspect, the latter being a counterproposal for energy policy (Maruyama et al. 2007). Community ownership comes into sight to have boosted the development of wind energy in Europe. Policies are put into effect, since public's acceptance of wind power, has enhanced. Citizens have perceived the interconnected benefits. (Aitken et al. 2016).

Ownership by local residents has demonstrated attractive in countries like Denmark and Germany, which have an uncomplicated, minimal risk, fixed tariff (Toke 2007; Toke 2005). Many case studies from different European countries showed that financial involvement of inhabitants evidently heightens their acceptance towards renewable energy. For instance a survey conducted in Scotland revealed increased acceptance on Giga Island where three wind mills are owned by the community (Warren and McFadyen 2010). In this case, the inhabitants are not directly financially involved, but it is the administration of the municipality being involved on behalf of citizens' concernment (Musall and Kuik 2011).

5 Energy in Greece

Public Power Corporation S.A. (PPC S.A.) is the major Greek electricity generator, providing electricity to approximately 7.5 million customers. Most of the country's electricity is generated at power plants in Northern Greece, in close proximity of the majority of the lignite mines, which is the primary fuel source. Some of the islands near the mainland are connected to the mainland's transmission system through submarine cables. The remaining islands are served by autonomous "oil- fired", generating power plants. Also, in some of the islands, the demand is covered by wind-powered facilities (PPC SA 2016).

PPC's environmental strategy includes the development of decrease greenhouse gas emissions' technologies. It also invests significantly in the increase of the renewable energy sources' share in electricity generation. PPC is the first corporation in the field of Renewable Energy Sources (RES) in Greece since 1982. PPC

Renewables, contribute to the exploitation of renewable resources. With 23 wind farms in island regions of Greece, they leverage the power of the wind. Their installed capacity is about 81.09 MW. PPC operates 17 small hydroelectric power stations with a total installed capacity of 65.35 MW. The sun's energy is utilized, producing electricity through 7 Photovoltaic Parks with a total installed capacity of 1.33 MW, currently in operation in the islands of Sifnos, Kythnos and Crete, the PPC Athens roofs and ETHEL stations, Metro and ISAP. Energy from geothermal and biomass sources are main priorities of the company's business plan (PPC SA 2016).

6 Wind Energy in Greece

Greece objectives' for 2020 (i.e., 20% of the national gross energy use and 20% of the national gross electricity use should be covered by RESs) demand a largescale incorporation of RES appliances.

However, accessibility of appropriate sites for the installation of those technologies is questioned. The fact that most of the sites, which are potentially able to support RES infrastructure have already been identified does not seem to be an installation indication, as the community resistance frequently poses further stumbling blocks (Kaldellis et al. 2012).

The development of civilization in the Greek islands was based on the power of the wind. The local populations had developed ways to enable their everyday life demands based on the advantages of powerful winds. The traditional windmills, characterizing the Greek islands, were such operations. In the Aegean islands the sea wind intensities of 8–10 Beauforts are a familiar fact of life. Greece, particularly in Aegean Archipelago and the mainland shores, possesses some of the best wind potential sites in the world. On the other hand, it is noticeable that over 50% of Greece's CO_2 emissions come from electricity generation, fact that highlights the insignificance of using wind power (Fragoulis 1994). The reliance on imported fuel (nearly 70% of its domestic energy use is imported), results in substantial exchange loss, particularly with countries outside the European Union (Kaldellis 2005).

The rapid installation of an enormous number of gigantic wind turbines in a few areas resulted not only in stern backlash from the locals but also led to termination of new RE installation projects in other places. A good example is Southern Euboea, with wind farms, which pushed the operational capacity of the area to nearly 50% of the total wind capacity in Greece. Euboea was perceived as an example to be avoided, because of the development of a skeptical outlook toward new wind parks, largely as a result of extraordinary wind power concentration in a condense time frame. This scenario sent damaging implications to all over the country. On top it has been seen in several cases, in Greece, that investors and individuals trying to introduce wind energy in a particular area were met with unwelcoming and aggressive responses from the locals who were not well informed in advance, or were not invited to participate in the project planning or they were

feeling that they were giving their land for free. There were also reported instances where locals were motivated by local authorities (Kaldellis 2005). It has also happened that sometimes a small group would stoutly oppose to wind turbines installation, for reasons of personal financial interest (Skanavis et al. 2014).

7 The Case of Skyros Island

Skyros, located in Central Aegean Sea, is the biggest island of the Northern Sporades complex. It is though considered a small Greek island and appeals to investors for wind energy appliances due to the admirable wind potential. The island peaks at almost 4 MW the year in energy demand and shows a yearly energy consumption of 15 GWh (Kaldellis 2011). The electricity is generated by six internal combustion engines, which burn fuel oil as diesel, transferred to the distribution network of Skyros and serves all consumers through the electrical installations in the region (Dimitropoulos and Kontoleon 2009).

Skyros is moderately well-known for numerous endangered species, such as the Skyrian horse. In the southern part of the island lies the highest mountain of Skyros Mount "Kochylas" (alt. 792 m), which has been included since 2006 in the European Nature Conservation Network "Natura 2000" and a "Site of Community Importance" (SCI), an area of 4096.7 hectares and "Special Protection area" (SPA), with code GR2420006 "Skyros, Mount Kohilas". Moreover, it has been characterized as "Important Bird Area of Greece "(IBAs) with code" GR115 Mount Kohilas". Also the "Islets Skyros" is also recorded as a SPA with code GR2420009, an area of 466.0 hectares (Xanthoulis 2011).

7.1 Wind Farm Installation at Skyros Island

On April 28th, 2005 the Consortium named "Wind of South Skyros—Holy Monastery of Megistis Lavras of Holy Mount Athos—ENTEKA SA", established at the initiative of and controlled by the Holy Monastery of Megistis Lavras, as the only considerable financial investor (participation 95%), submitted to the Regulatory Authority of Energy (RAE), ten applications for the granting of an equal number of production licenses of wind farms, total three hundred thirty-three (333) MW, corresponding to an equal number of wind power stations, total hundred and eleven (111) wind turbines rated at 3 MW each of them, in the administrative and territorial region of the island of Skyros, (particularly in southern Skyros) the mount "Kochylas".

On June 17, 2009, the aforementioned service responded with a positive opinion for the entire project. Based on the above, on May 10, 2010, the consortium was given permission to nine wind plants, 111 wind turbines for the total requested total power of 333 MW.

It is noteworthy to say that Skyrians, both residents and administrators haven't been followers of "Not In My Back Yard" idea. In 2007 the City Council has decided in favor of wind power, but with a number of turbines not exceeding the indispensable ones to meet the island' s energy demands. In 2010 City Council, endorsed the increase of energy production from renewable sources, accepting the installation of a small-scale wind farm of 24 MW, which was twice the island's needs in peak season. The Skyrian local society on 5th of April 2008, at a mass assembly issued a "Resolution" which unanimously opposed the installation of 111 turbines. In July 16th, 2010 they signed "The memorandum of protest and opposition to the installation of nine wind farms (111 turbines, power 333 MW) on the island of Skyros" (Xanthoulis 2011). Until today, the Skyrian community is alerted against wind energy installation.

8 Methodology

In the summer of 2016, a questionnaire-based survey supplemented with semi-structured, face-to-face interviews was administered to Skyros Island residents. The primary aim of the survey was to test the hypothesis that community ownership leads to greater public acceptance to wind power, regarding the effort to make more sustainable the Island of Skyros.

The questionnaires focused on topics related to climate change knowledge, perceptions, effects of climate change and the participants' beliefs and perceptions on wind energy and wind ownership. The questions of the questionnaires were based in prior studies and the selection of the sample was random selection of residents of the specific port during the month of July 2016. The actual residents of the port village are 500 so a total of 10% of them comprised the chosen sample. The response rate was 75%.

As aforementioned, the sample was composed of Skyrian inhabitants; aged 16–61 years old (5% up to 18 years, 45% 18–40 years, 45% 41–60 years and 5% over 61 years). Sixty per cent were male and the rest female participants, while the vast majority had tertiary education (55%), a 15% had a Master degree of Science and a 30% had completed secondary educational level. Regarding their marital status, the 35% of the respondents were single, the 15% were married with no children, the 40% were married with children and a 10% were divorced. Moreover the majority (55%) of them lived at Skyros Island from 1–10 years, the 25% between 11–20 years and the 20% more than 21 years.

9 Results

9.1 Skyrians and Environmental Issues

Several questions regarding knowledge, attitude and behavior towards key environmental issues were included in the survey questionnaire. Table 1 presents Skyrians' perceptions towards environmental issues and Fig. 1 shows the Skyrians' beliefs about the most serious problems the planet is facing.

Also, the inhabitants asked to express their opinions about what alterations they were willing to undertake to reduce the vulnerability of the country environmental issues such as climate change, and their answers are presented in Table 2.

Figure 2 shows the undertaken actions aiming to tackle environmental problems such as climate change.

In the sequel, they were asked who should be responsible for financing environmental adaptation measures and their answers are presented in Fig. 3.

Table 1 Skyrians' perceptions towards environmental issues

	Strongly agree (%)	Agree (%)	Slighty agree (%)	Disagree (%)	Strongly disagree (%)
You are very concerned about environmental issues such as global warming and climate change	40	40	15	0	5
Your actions to reduce the impact of environmental issues such as of global warming and climate change in your area will encourage others to do so and be more sustainable in their lives	45	30	20	0	0

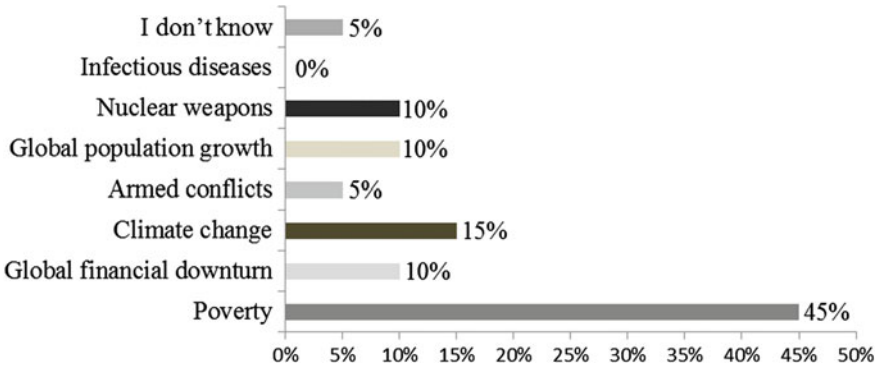

Fig. 1 Skyrians' beliefs about the most serious problem the world is currently facing

Table 2 Changes the inhabitants are willing to make in order to reduce the vulnerability of the country to environmental issues like climate change

	Agree (%)	Disagree (%)
Support renewable energy	70	30
Support environmental policies	30	70
Driving hybrid vehicle	30	70
Using mass transportation means	50	50
Less driving	10	90
Using CFLs	20	80
Reuse and recycle materials	65	35

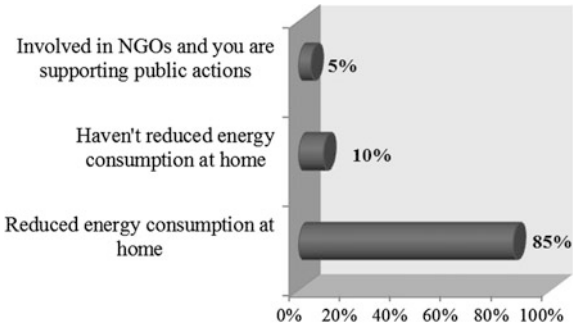

Fig. 2 Skyrians' actions aimed to tackling environmental problems, such as climate change

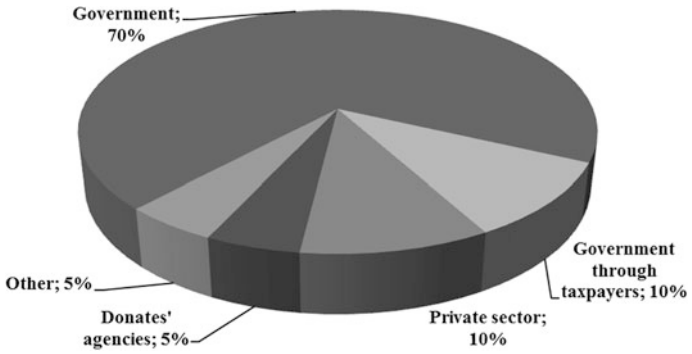

Fig. 3 Residents' beliefs about who should be responsible for financing environmental adaptation measures

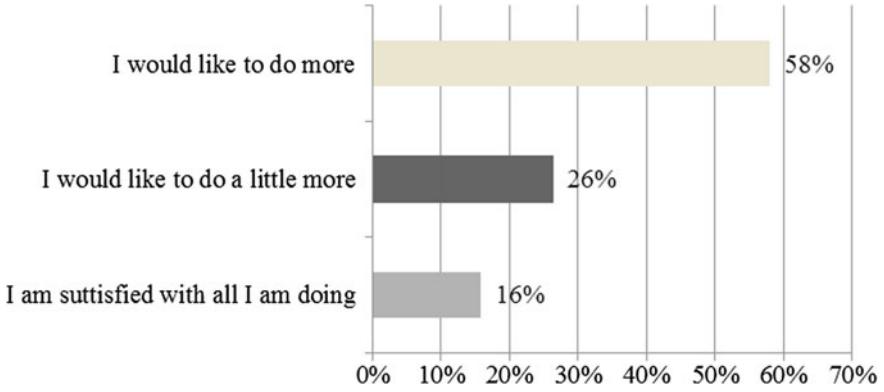

Fig. 4 Skyrians' beliefs about their current lifestyle and the environment

In Fig. 4 are presented the inhabitants' beliefs about their current lifestyle and the environment.

Furthermore, a percentage of 68% of Skyrian civilians had the will to support measures that promote sustainability, for instance support measures that reduce greenhouse gas emissions (e.g. environmental taxes), while the 32% hadn't such intention.

9.2 Energy and Wind Energy

Numerous questions regarding energy and wind energy were included in the survey questionnaire and the answers of Skyrians are presented in Fig. 5 and Table 3.

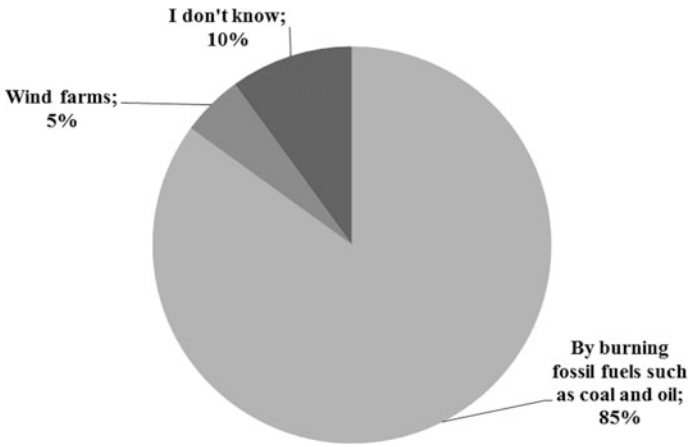

Fig. 5 Skyrians' opinion about how it is generated the bulk of electricity in Greece

Table 3 Skyrian's perceptions towards energy, wind energy and installation of wind farms

	Agree (%)	Disagree (%)
You are aware of energy policy for the installation of wind farms in Greece	55	45
The local electricity power station of your region does contribute to climate change and the environmental degradation	35	65
Using renewable energy the impacts of climate change are reduced and thus sustainability is promoted	90	10
The way that the electricity produced in Greece is required to be replaced immediately by renewable energy sources	95	5
The generation of electricity from wind power, will significantly contribute to reducing climate change and thus promote sustainable development	85	15
You are positive with the installation of wind turbines in your region	45	55
If the policy towards the installation of giant wind farms changed with small wind farms, it would help spreading of wind energy and thus the sustainability	85	15
You supported the installation of the giant wind farm in Skyros a few years ago, and you were not one of the inhabitants who opposed the installation	26	74
In case you didn't support it, you would participate to actions such as protests, letters to mass media etc	58	10
You participated in the decision making for the installation of the giant wind farm at Skyros a few years ago	42	58
If you didn't participate, you would participate in case that it repeated again	53	5
You were satisfied from the communication part of the giant wind farm installation by the local authorities	47	53
If financial incentives were given (allowances, reduced tariffs PPC etc.) to residents of Skyros, they would accept the installation of a giant wind farm	37	63
If the issue of the implementation of the wind farm entered again into effect, you would support it	26	68
You are positive for the installation of a small scale wind farm, which will cover the energy needs of Skyros, owned by local inhabitants rather than large companies	95	5
Being owners of wind turbines the inhabitants of a region, it would help to accept the setting and thus to "spread" more easily wind energy in Greece	84	16
It should be allowed to inhabitants to install wind turbines. Additionally, government should provide financial incentives or subsidy for it (as it does with photovoltaic parks)	74	26
You have the will to support a move that would be targeted in the shutdown of a power plant in your area, because the way, in which the energy produced there is oil fired, to be replaced by a wind farm that will cover the island's energy needs	79	21

10 Discussion

The results of the present survey demonstrate that community ownership does not transform an overall negative aspect of wind power into a positive one; attitudes in the wider population are already broadly positive. What it appears to principally do is to amplify pre-existing positive attitudes and suppress negative ones. Therefore, the promotion of a more locally embedded approach to wind energy projects (whether through community ownership or energy cooperatives) could help to ease the incidence of damaging and divisive controversies, which currently afflict wind power development in Greece. In turn, this would help to facilitate the achievement of renewable energy targets and consequently the implementation of sustainable policies, as well.

10.1 Skyrians and Environmental Issues

Results presented in this research regarding general environmental issues make obvious that Skyrians appeared to be quite environmentally conscious, although some issues puzzle them, mainly misconceptions. The results of Fig. 1 showed that most Skyrian inhabitants believed that the most serious problem the planet is facing is "poverty" (45%), while at the same time the majority of them appeared to be very concerned about environmental issues like climate change and global warming, and most of participants felt that their actions to reduce the impacts of environmental issues like global warming and climate change could encourage others to do the same thing (Table 1).

Additionally, as it is revealed in Table 2 most of Skyrians were willing to support Renewable Energy (70%), to drive less (90%), reuse and recycle materials (65%), in order to reduce the vulnerability of the country to environmental problems, such as climate change. While simultaneously, they were willing to reduce energy consumption at home in a high percentage of 85 (Fig. 2).

10.2 Skyrians, Energy and Wind Energy

Anterior researches indicated that at a national level, the acceptance of RES is sublime and there is also an extraordinary acceptance of grid expansion, when it helps to increase the share of RES in the system. In terms of local acceptance, barriers that were confronted the most, were interrelated to technologies and landscape modification (Bertsch et al. 2016). Skyros Island community give the impression to be positive to RES. Residents were well-informed about the energy generation in Greece, and they believed in their vast majority (90%) that the usage of renewable energy could contribute to the reduction of climate change impacts

and thus sustainability is promoted, while 95% of them said that the way the electricity is generated in Greece should be immediately replaced by RES.

Results, presented in this paper, regarding general attitudes towards wind energy brace prior research findings (Swofford and Slattery 2010; Devine-Wright 2005; Krohn and Damborg 1999), which signify an overall public support for wind energy. In general, Skyrians showed a positive attitude towards the wind farm and wind energy technology, since the vast majority (85%) of them said that the generating electricity by wind energy, would significantly contribute to climate change decline and consequently it could strengthen the promotion of sustainable development. In addition to this, the majority (79%) of the respondents preferred wind power as a mean to electricity generating instead of fossil fuels' use, which happen to be detrimental to the environment.

In contrary, only a 45% held positive attitudes to the installation of a wind farm in their region. This enables a deeper understanding of the social and psychological aspects of change arising from the lodgment of energy technologies in specific locations. Emotional attachments to place are potent, and any disruption to these attachments can influence an individual's attitude and alter conducts (Devine-Wright 2009). This is predominantly in accordance with the facts for a wind energy landscape, which involves an energy source that is particularly visible. Some people consider that the installation of wind turbines is a violation to the natural landscape (Swofford and Slattery 2010; Pasqualetti 2000). This finding is identified in this case study too. Preceding literature has stated that visual impact is the most significant environmental issue correlated to wind energy (Wolsink 2007; Pasqualetti 2000; Thayer and Freeman 1987). Levels of environmental concern will assuredly vary by location and will be contingent on local context and place attachment (Swofford and Slattery 2010; Devine-Wright 2009; Vorkinn and Riese 2001).

Most of the respondents (74%) were in contradiction of the installation of a large-scale wind farm, owned by an independent company, almost a decade ago. Additionally, they would have been negative again, a response from 68% of respondents, if the issue of the installation of a giant wind farm was up to come again in the forefront. On the other hand, furthermost of them (58%) didn't participate in decision making about the installation of the giant wind farm a few years ago, but a 53% of interviewees stated that they have changed their minds and would participate in a future decision making and actions to prevent the installation, such as protests or letters to mass media.

Obviously Skyrians' negative attitudes were not the results of a Not in My Back Yard attitude. An 85% believed that small-scale wind farms would increase public acceptance and contribute to the spread of wind energy use at Skyros Island. While simultaneously it would promote the sustainability in their island and in the whole country. This was also identified by the fact that almost all of them (95%) had positive attitude for small-scale wind farms, which would cover the energy needs of the island and the owners would have been the residents themselves.

Moreover, most Skyrians (84%) believed that through the community ownership it would be easier to "spread" the wind energy concept in Greece, since it could

contribute to increasing the public's acceptance and provide sustainable development.

Regarding the communication part of the giant wind farm installation from the local authorities, found 47% of Skyrians satisfied while the 53% not. They seemed to have lost their trust into local authorities. As Skanavis et al. (2014) discerned in a prior research project about the case of wind energy at Skyros Island, trust between citizens, investors of RE and representatives of local governance is fragile and once it has broken, it would be extremely difficult to be earned again.

10.3 Research Limitations

The participants of the survey were residents of the port fund Linaria, who surely have more communicational opportunities with other cultures and consequently they are probably more open- minded. The survey should be implemented into other remote regions of the island.

11 Conclusions

Nowadays, islands are facing the most challenging time. Due to the increasing needs of energy and water, the change in lifestyle, the sea level rise owing to climate change etc., the resilience of the islands' ecosystems are affected. So, regarding their fragile environment the conservation of the islands' resources is imperative, since they are natural laboratories for sustainable development and integrated solution concerning energy, water, waste and mobility. Undeniably, Greek islands should cope with these challenges, providing sustainable solutions to increase energy availability and efficiency. Unlike traditional absentee-owned huge wind farms, community wind typically is characterized by local ownership and a small size. It often "consists of relatively small utility-scale wind power projects that sell power on the wholesale market and that are developed and owned primarily by local investors" (Yin 2013; Bolinger 2011). Arguably the most significant finding, including results from this research project, concerns the positive influence of an ownership model on the attitudes of communities towards wind energy projects (Warren and McFadyen 2010). This point supports the long-held supposition that the above-mentioned model could increase public support for windfarms in Skyros and other parts of Greece.

Locals are likely to be against proposed projects, if they think they are not sufficiently informed and knowledgeable about wind energy and wind parks. Skyros has experienced by far more reactions down this line, probably because wind power energy potential has been on the local agenda for few years. In Skyros, some years ago, two power turbines were installed at a quite visible landscape location and then were left broken and abandoned for many years after their

operating had permanently ceased. This incident has left the residents quite bitter and resistant into accept another source of such ugliness (Skanavis et al. 2014). Further, people at Skyros demonstrated a higher willingness to accept compensation for the installation of wind power (Dimitropoulos and Kontoleon 2009). The results of a prior study show that participants would like to have access to an appropriate non formal/informal environmental education that will help them in increasing their knowledge and obtaining skills for critical thinking and vigorous contribution in the wind energy alternative (Skanavis et al. 2014, 2005).

Education is the key towards awareness, knowledge and sustainability. As a summary, Education for Sustainable Development (ESD) is important to enlighten and create sustainable lifestyle and sustainable cities. Education for Sustainable Development allows every human being to obtain the knowledge, skills, attitudes and values necessary to shape a sustainable future. It also requires participatory teaching and learning methods that motivate and empower learners to change their behaviour and take action for sustainable development. Subsequently, ESD encourages capabilities like critical thinking, visualization future scenarios and making decisions in a cooperative mode. So, it is an imperative element if cities are to become sustainable with highly sensitized citizens (Yin 2013).

Societies have very dissimilar levels of information resources, as well as or the trust and social comprehension levels which are built up through their interactions with other actors, institutions and initiatives over the years (Bristow et al. 2012; Shucksmith 2010). Investing into quality energy resources education and transparent communication of energy implementation strategies lead to desirable environmental sustainability outcomes. Additionally environmental degradation declines and public acceptance of environmentally friendlier energy technologies and policies rises.

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Prerequisites for Energy Sustainability in Municipalities in Rio Grande do Sul, Brazil

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Abstract The increased demand for energy in cities and the higher frequency of energy crisis justify the existence of more research discussing the issue. The aim of this chapter is to discuss the situation of the energy matrix and the electricity consumption in the South of Brazil, in order to identify challenges and opportunities to improve the energy sustainability. The study shows the results of the Energy work package of the project Prerequisites for the sustainability of municipalities in Rio Grande do Sul (PRESUST-RS) and include the diagnosis, the search for best practices and the selection of the most suitable practices for the municipalities. Initially a group of indicators for the diagnosis of the energy sector was selected and the data collection was taken from secondary sources. After that, best practices were searched, seeking case studies in the literature. The selection of those that could be implemented in the cities was made through meetings with groups of stakeholders in each city, characterizing a study of lifelong learning, in which the community could vote for their preferred practices after discussing the importance and challenges of each one. The results indicate that the electricity consumption has been increasing in cities, but Rio Grande do Sul has a high percentage of supply of this energy from renewable sources. Moreover, the practices chosen by the community mainly address the use of technology and renewable energy.

Keywords Sustainable cities · Energy efficiency · Energy matrix

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1 Introduction

In the last decades, cities have been implementing initiatives aimed at updating the urban infrastructure and its services, precisely to comply with the three pillars of sustainability. The goal of its implementation in general is to improve the quality of life in urban environments, using scientific and technological innovation, sustainable infrastructure and building an informed and conscious society with participatory communities (de Jong et al. 2015).

Lifelong learning is one of the ways to build a conscious and participatory society, which undoubtedly contributes to the formation of more sustainable cities. According to Laal (2011), lifelong learning results from integration of formal, non-formal, and informal learning to create ability for continuous lifelong development of quality of life, not only developing individuals to become responsible to themselves and their communities, but also to understand and involve actively at all levels of their societies.

Wolf et al. (2016) presents a practical example of lifelong learning in the field of energy, outlining its relevance in a Small Islands Developing States context. The authors argued that more effort should be placed in capacity building, focusing on lifelong learning in the area of energy, as a valuable crosscutting measure to address the chronic human capacity problem that constrains the quicker uptake of sustainable energy technologies. This approach is valid to energy sustainability also in developed and developing countries.

Considering this and the fact that energy demands represent a global problem which must present local energy solutions, such as sustainable energy programs in cities (Radulovic et al. 2011), projects that discuss energy and sustainability become increasingly necessary. Thus, it will be possible to meet the climate change mitigation requirements and also guarantee energy security in the municipalities.

According to the United Nations (2010), the energy theme is divided into three broad areas: energy access, renewable energy and energy efficiency. It was within this perspective that the project "Prerequisites for the sustainability of municipalities in Rio Grande do Sul" (PRESUST-RS) defined the approach of one of its work packages, focused on energy.

The PRESUST-RS project focused on the challenges and sustainability practices in cities, addressing lifelong learning as a tool to discuss it with local stakeholders. The project was created with the aim of spreading sustainable practices and making the local community aware of the importance of its participation, given that sustainable development has been more of a concept than an actual practice (Brandli et al. 2017).

The project was limited to three municipalities in the southern region of Brazil, namely Passo Fundo, Porto Alegre (the capital of Rio Grande do Sul state) and Santa Maria. The steps included:

(a) Diagnosis of each work package, through the selection and analysis of indicators, in order to verify the current situation of the cities and region about each theme;

(b) Best practices research, including sustainable solutions, innovations and insights from other cities in Brazil or in other countries, related to each work package;
(c) Application of lifelong learning approach, by mobilizing stakeholders in each studied municipality, promoting awareness through meetings and workshops, and also promoting dissemination of best practices, asking them to vote for their preferred practices after discussing the importance and challenges of each one.

During this last stage, the PRESUST-RS group made theoretical explanations, regarding all work packages related to urban sustainability, and group dynamics to enhance participation and learning of the participants.

Although the PRESUST-RS project did not intend to implement sustainable practices, it hoped to create and mobilize the necessary support for the diagnosis of cities and awareness of practices that should be applied to the local community, besides the pursuit of education, information and understanding of the importance of this issue for life in society (Brandli et al. 2017).

2 Energy Work Package and Its Indicators

PRESUST-RS project selected Energy as one of its work packages since it is an important subject when it comes to sustainability, sustainable cities and urban infrastructure. The study focused in the southeast state of Brazil, Rio Grande do Sul, and in the cities of the project, Passo Fundo, Santa Maria and Porto Alegre. Some characteristics of them are presented in Table 1 (Brazilian Institute of Geography and Statistics [IBGE] 2017), where is it possible to note that Porto Alegre is a larger city in terms of population (and also development) when compared to the others.

The energy sector is quite wide, including approaches of primary energy supply, electricity consumption, fossil fuels, renewable and non-renewable sources, among others. Electricity, in turn, also presents several applications, such as residential, industrial, commercial, rural, public sector or public lighting consumption. In order to delimitate the study, the energy work package was subdivided into two others: energy matrix and energy efficiency. The first one analyzed energy supply in the

Table 1 Characteristics of Rio Grande do Sul state and municipalities

	Estimated population —2016 (inhab.)	Area—2015 (km²)	HDI—2010
Passo Fundo	197,798	783.42	0.776
Porto Alegre	1,481,019	496.68	0.805
Santa Maria	277,309	1,781.76	0.784
Rio Grande do Sul	11,286,500	281,737.95	0.746

state of Rio Grande do Sul in regards to its energy matrix and the second one focused in electricity consumption in the studied cities and some consumption sectors. Table 2 shows the indicators selected for the Energy work package.

The indicators were chosen based on their relevance and availability in each municipality, after research in sources like the National and State Energy Balance (Brasil 2015; Capeletto and Moura 2015), Sustainable Cities Program (Programa Cidades Sustentáveis 2012), and the ISO 37120:2014 standard (International Organization for Standardization 2014), about indicators to sustainable development in communities.

The source of the information consists basically of the National and State Energy Balances, the Economics and Statistics Foundation, the Brazilian Institute of Geography and Statistics and the Brazilian Electricity Regulatory Agency.

3 Energy Diagnosis

Table 3 shows the results for analysis of indicators of Energy Matrix, considering 2014 as reference year. The energy matrix of Rio Grande do Sul has high levels of non-renewable energy in relation to the Brazilian matrix. There is a strong predominance of non-renewable sources, 62% of which is petroleum, 11% coal and 3% natural gas. The other sources are firewood and hydropower, with 7 and 10% of the total supply, respectively. The last 7% are other renewable sources.

Therefore, in 2015, Rio Grande do Sul presented only 24% of its energy matrix from renewable sources. The percentage of non-renewable sources is due to the high consumption of petroleum products.

As for wind energy, it has contributed to the energy matrix since the inauguration of the Wind Farm in the region of Osório in 2006, which used to be the largest park in operation in Latin America. In 2015, The Wind Energy Complex Campos Neutrais became the largest wind farm in the region, with a 402 MW operation capacity (Capeletto and Moura 2015).

Most of the domestic electricity supply comes from hydroelectric sources, which is very positive from the sustainability point of view, but with periods of climatic instability, the thermoelectric source is used more and receives extra incentives. Therefore, it can be seen that the domestic electricity supply behaves inversely to the domestic supply of primary energy, since 77% of its energy matrix consists of renewable sources, almost four times higher than the world average (21.2%) (Brasil 2015; Capeletto and Moura 2015).

Analyzing the final energy consumption in Rio Grande do Sul, the most consuming sector is transportation, accounting for almost half of all the energy consumed in the state. This modality justifies the high consumption of non-renewable energy in Rio Grande do Sul, since 88% of the energy consumed by the transportation sector is from non-renewable sources. In the year 2015, approximately half of the total consumed came from diesel, followed by gasoline with 35% and the

Table 2 Indicators selected for the PRESUST-RS Energy work package

Energy matrix		
Indicators	Components	Unit
Domestic primary energy supply by source	Domestic supply of primary energy by source (toe)	%
	Total domestic energy supply (toe)	
Share of renewable energy sources in primary energy supply	Domestic supply of primary energy from renewable sources (toe)	%
	Total domestic energy supply (toe)	
Domestic electricity supply by source	Domestic supply of electricity by source (TWh)	%
	Domestic supply of total electric power (TWh)	
Share of renewable energy sources in electricity supply	Domestic supply of electricity from renewable sources (toe)	Omestic supply of primary energy b
	Domestic supply of total electric power (toe)	
Final energy consumption by sector	Energy consumption by sector (TWh)	%
	Total energy final consumption (TWh)	
Share of renewable energy sources by sector consumption	Sector consumption by renewable sources (TWh)	%
	Total consumption by sector (TWh)	
Energy efficiency		
Indicators	Components	Unit
Total electricity consumption per capita	Total electricity consumption during the year (kWh)	KWh/inhab. year
	Total population	
Total electricity consumption	Total electricity consumption during the year (kWh)	MWh
Percentage increase rate of total electricity consumption (2010/2015)	Difference between the electricity consumption in a 5 years-period (MWh)	%
	Electricity consumption of the period first year (MWh)	
Electricity consumption by sector (household, industry and trade)	Electricity consumption for each sector during the year	MWh
Total number of consumers	Number of electricity consumers	un.
Percentage increase rate of total number of consumers (2010/2015)	Difference between the number of electricity consumers in a 5 years-period	%
	Number of electricity consumers in the first year	
Number of consumers by sector (household, industry and trade)	Number of electricity consumers by sector	un.

(continued)

Table 2 (continued)

Energy matrix		
Indicators	Components	Unit
Electricity consumption by sector consumer unit (household, industry and trade)	Electricity consumption by sector per year (kWh)	kWh/consumer unit
	Number of electricity consumers by sector	
Percentage of households with electricity supplied by the distribution company	Number of households with electricity supplied by the distribution company	%
	Total number of households	
Percentage of households with public lighting	Number of households with at least one public lighting pole in their street	%
	Total number of households	
Residential electricity fee	Residential electricity fee charged by the distribution company in each municipality	R$/kWh

sum of biofuels (ethanol and biodiesel) was in the third position, representing with 11.5% of the total.

Unlike the transportation sector, the others owe most of their consumption to renewable sources. The largest fraction of industrial and residential consumption is electricity, while for agriculture and livestock it is firewood.

The Energy Efficiency part of the work package selected indicators for general analysis of the electricity sector in cities, regarding consumption, number of households receiving adequate service and amount paid, in order to present to the community, subsequently, the general panorama observed. Its result is presented in Table 4.

According to the 2016 Statistical Yearbook of Electricity (Energy Research Enterprise 2016), the average per capita consumption in Rio Grande do Sul for the year 2015 was around 2593 kWh/inhab., showing that the cities under study are close to this pattern, although all of them have lower values.

With regard to the percentage rate of increase in electricity consumption and the number of consumers, it is generally observed that consumption grows at a higher rate than the growth of consumers—only Porto Alegre has a contrary situation. It is also interesting to note that the capital has the lowest growth rates; whilst Passo Fundo, for example, has the largest, which can symbolize greater economic development of this city.

When it comes to electricity consumption by sector, each city has a prominent sector in its context. In Passo Fundo, industrial and trade sector represent approximately 28% of the total consumption (each), while in Porto Alegre and Santa Maria the industrial sector represents around 7 and 10% of total, respectively. On the other hand, Porto Alegre has the trade sector with 43% of total consumption, while in other cities this value is close to 20%. The consumption of household

Table 3 Results for Energy Matrix

Indicators		RIO GRANDE DO SUL	Unit
Domestic primary energy supply by source	Petroleum	62	%
	Coal	11	
	Natural gas	3	
	Firewood	7	
	Hydropower	10	
	Other renewable sources	7	
Share of renewable energy sources in primary energy supply		24	%
Domestic electricity supply by source	Hydropower plant	64	%
	Coal	23	
	Wind energy	13	
Share of renewable energy sources in electricity supply		77	%
Final energy consumption by sector	Industrial	21	%
	Residential	13	
	Transportation	46	
	Trade	5	
	Public	2	
	Agriculture and Livestock	8	
	Energy sector	5	
Share of renewable energy sources by sector consumption	Industrial	62	%
	Residential	76	
	Transportation	12	
	Agriculture and livestock	99	

Source data from Capeletto and Moura (2015)

sector has more prominence in Santa Maria, where it represents 50% of total, while in other cities this value is close to 35%.

Regarding the percentage of households in each municipality with electricity supplied by the local distribution company and with public lighting, it is verified that practically all households are served, but it is important to consider that, with regard to social equity, the ideal value would be 100%, and that a small percentage without this represents innumerable residences without quality service, without quality of life and without crime prevention.

The final analysis of this work package shows that although the state has a very good result in terms of sustainability in consumption of electricity supplied by renewable energy sources, this predominance is due to the great hydroelectric

Table 4 Results for Energy Efficiency

Indicators		Passo Fundo	Porto Alegre	Santa Maria	Unit	Base year
Total electricity consumption per capita		2159	2432	1937	kWh/inhab./year	2015
Total electricity consumption		425,802	3,589,470	531,470	MWh	2015
Percentage increase rate of total electricity consumption (2010/2015)		24.4	6.4	15.3	%	2010/2015
Total number of consumers		84,092	597,759	115,835	un.	2015
Percentage increase rate of total number of consumers (2010/2015)		15.2	8.7	12.2	%	2010/2015
Electricity consumption by sector	Households	163,285	1,255,614	263,553	MWh	2015
	Industries	113,327	259,632	54,808		2015
	Trade	120,766	1,546,463	133,812		2015
Number of consumers by sector	Households	75,772	513,033	105,382	un.	2015
	Industries	459	4134	409		2015
	Trade	7272	78,621	6962		2015
Electricity consumption by sector consumer unit	Households	2155	2447	2501	kWh/consumer unit	2015
	Industries	246,900	62,804	134,005		2015
	Trade	16,607	19,670	19,220		2015
Percentage of households with electricity supplied by the distribution company		99.6	99.3	99.0	%	2010
Percentage of households with public lighting		97	94	96	%	2010
Residential electricity fee		0.41	0.39	0.47	R$/kWh	2015

Source data from Economics and Statistics Foundation [FEE] (2017), Brazilian Institute of Geography and Statistics (2017) and Brazilian Electricity Regulatory Agency (2016)

potential of the country, as well as to its large area, which represents an advantage in hydraulic generation. On the other hand, according to Costa and Valadão (2015), during national water crisis, it is observed that non-renewable sources tend to have their increased participation in the energy and electric matrix. Also, the recent Energy Plan of Rio Grande do Sul states that there are no policies focused on energy efficiency, thus depending solely on national measures (Secretaria de Minas e Energia 2016). In this context, municipalities need to invest in local measures to reduce their energy consumption, or to support the use of alternative energy by each sector, which would be very positive for energy sustainability, aiming at a greater diversification of alternative sources in the state and in the country as a whole.

4 Energy Best Practices

In terms of energy sustainability, there are several practices being applied in international and also national level. Some of them are more complex, involving a high investment, and others are simpler, but not less important considering practical results for cities. Table 5 presents a summary of six best practices related to energy, found in the review of sustainable solutions and innovations, along with the source of some application examples.

There are two practices directly related to the use of renewable energy sources: *Photovoltaic pavement for energy generation* and *Photovoltaic system in parking lots*. Both of them suggest the implementation of photovoltaic cells in order to take advantage of areas that are not originally concepted for that, having their own propose. The roads, considered only for traffic, and the roof of parking lots, apparently useful just for covering, can be transformed in one more option for solar energy generation.

Kolokotsa (2017) presents the idea of Solaroad project (http://en.solaroad.nl/), applied in the Netherlands, where photovoltaic panels are being incorporated in the

Table 5 Summary of Energy best practices

Practice	Description	Sources
Photovoltaic pavement for energy generation	Traditional pavement is substituted for photovoltaic cells, taking advantage of road areas also to energy generation	Dezfooli et al. (2017) Efthymiou et al. (2016) Kolokotsa (2017)
Tax incentives or discounts to promote investments in sustainable projects	City government gives tax incentives or discounts to promote the adoption of sustainable measures in properties	de Melo et al. (2016) Riondet-Costa et al. (2016)
Energy efficient public lighting	Consists in the retrofit of public lighting system using LED bulbs, contributing to energy savings, financial gain and reduction of greenhouse gases emissions	World Bank (2016) Vahl et al. (2013) Polzin et al. (2016)
Photovoltaic system in parking lots	Covering parking lots with photovoltaic cells consists in a measure to increase the use of renewable energy in a useful area	Congedo et al. (2013) Nunes et al. (2016)
Use of municipal solid waste for energy generation	Generation of renewable energy through solid waste that would be daily sent to treatment and potentially wasted	Jewitt (2011) Chen et al. (2017) Korai et al. (2017)
Energy efficiency campaigns	Cities can promote campaigns that encourage the conscious use of energy and the exchange of old equipment for more efficient ones, by reduced cost	Energisa (2017) Shen et al. (2016)

road and exploiting large surfaces within cities to generate electricity, used by local users. The first prototype was applied in a bicycle path 70 m long, with refabricated slabs made by concrete modules of 2.5 m × 3.5 m with a translucent layer of tempered glass, which is about 1 cm thick. Underneath the glass are allocated the silicon solar cells. Some tests already showed the potential of energy generation for the household sector, and must be expanded to more purposes.

Other authors still work with the evaluation of feasibility of using solar pavements as a sustainable energy producer to supply electrical energy in the context of pavement, by embedding solar/photovoltaic cells between rubber layers, since it plays an important role in the future decarbonized energy supply for various applications (Dezfooli et al. 2017). Simulation models are also being used with experimental data, and studies show that the photovoltaic pavement use can contribute even to heat island mitigation, by achieving a surface temperature decrease, especially because pavements cover a very high percentage of the urban surface and seems to be one of the most important proposed areas for this phenomenon mitigation (Efthymiou et al. 2016).

Concerning the use of solar parking lots, most papers propose their use for development of clean solar electricity and electric mobility, by means of providing shade and generating electricity to charge parked electric vehicles (Congedo et al. 2013; Nunes et al. 2016). These authors study the development of integrated management system for special infrastructures of public use, investigating the productivity of plants placed in different areas, and discuss the need of exploring the potential of parking lots to energy generation, using technical, environmental and financial issues. In Brazil, electric vehicles are not largely used, but the idea can be applied, for now, to supply the energy demand of the parking lot and to be redistributed in the grid for other establishments.

At the same time as it increases the energy supply, these practices also use a renewable energy source, contributing to city sustainability, decarbonized energy supply and regard an increasingly important solution to deal with the climate change challenges and energy security.

The practice of *Tax incentives or discounts to promote investments in sustainable projects* is an important step to expand the number of projects applied in cities. In Brazil, there are some tax exemptions for companies that buy or import some types of equipment for infrastructure projects, discounts in distribution and transmission tariffs for solar plants, and also exemption of tax charged for wind and solar generating equipment (Melo et al. 2016). The downside is that initiatives are mostly applied for investidors, as a big investiment. It is important to promote these kind of incentives or discounts also for small energy consumers (household and trade sector, for instance), by reducing fees for those with development of sustainable practices. It is used in some Brazilian cities, where public authorities are promoting discounts in the municipal property tax for establishments that use sustainable alternatives (Riondet-Costa et al. 2016), and it should be a model for other cities to promote these initiatives.

When it comes to *Energy efficient public lighting*, the use of LED bulbs can provide the same levels of lighting for lower energy consumption, reducing carbon

emissions and system costs (World Bank 2016). Considering that, Polzin et al. (2016) argues that technological, economic, institutional and competency barriers to retrofitting translate into transaction costs, that can be overcome if combined with investments among municipalities, municipal ownership and choice of appropriate governance structures for use of such technology. Studies comparing LED and other options of bulbs show that these have highest annual cost (at first may appear an economic alternative, but their lifespan is shorten) and toxic waste disposal, while LED becomes the most sustainable and economically attractive alternative (Vahl et al. 2013). This practice is positive when it comes to energy efficiency but also increases quality of life, public security and quality of public space.

The practice of *Use of municipal solid waste for energy generation* is interesting for adding value to waste, especially for having good potential for energy generation and being thrown away. Jewitt (2011) gives examples of uses of bio-energy generated by waste, such as provision of cooking and heating gas, electricity and vehicle fuel, in China, Germany and UK, showing that the huge potential of conversion has success in practice. But although using municipal organic waste to biological energy recovery is a hot topic, lack of pre-planning, infrastructure and public awareness contribute to worsening its management, mainly in developing countries, where this situation need to be changed, since waste treatment in order to produce bio-energy can contribute to reduction of imported energy and increase sustainable generation (Korai et al. 2017; Chen et al. 2017).

The last practice suggests *Energy efficiency campaigns*, that suit better in developing countries and specially to the population share that is not able to invest in more energy efficient products. Shen et al. (2016) describe the importance of economic incentive instruments to success of efficiency initiatives, but also point out that it requests a consistent level of funding and changes of government policies. In Brazil, the Energisa Group invest in campaigns aiming to encourage the purchase of low energy consumption products with some percentage discount (Energisa 2017). This kind of practice could be applied by public authority, giving opportunity to more people to have energy efficient products and contributing to reduce the energy consumption in cities.

5 Lifelong Learning Approach: Selection of Best Practices for Municipalities

In order to select best practices for the municipalities, technical visits were initially made to governmental and non-governmental organizations in the municipalities under study aiming to establish partnerships and identify local stakeholders. The partnership was made with NGOs, governmental spheres and Neighborhood Residents Associations. There was the possibility of different social actors to join the group, increasing the community extension of the university and including people over 18 years old who played a relevant role in the place where they live or

work, regardless of the degree of education (the groups included community health agents, NGOs representatives, public servants, teachers, among others).

The approach of lifelong learning was made through the presentation of best practices and discussion of its advantages and challenges. After this presentation, the participant community was asked to indicate which practice(s) would be the most successful if implemented in the city, and which would also bring the greatest benefits.

In Passo Fundo, the stakeholders highlighted the public policies as an important factor of incentive to the implementation and use of alternative energy sources in residences and enterprises. Giving benefits to people who supply their places with solar or wind energy would be one of the tactics that could be used. It is worth mentioning that the practice of "Tax incentives or discounts to promote investments in sustainable projects" would be the ideal partner according to stakeholders to assist this subject.

The stakeholders of Porto Alegre indicated the same practice as the group of Passo Fundo, evidencing the implementation of alternative sources for electricity generation in households. Therefore, the most appropriate practice would also be the implementation of "Tax incentives or discounts to promote investments in sustainable projects". The group also highlighted the need of replacing conventional light bulbs for LED ones, in order to reduce financial costs, promote greater visibility in public spaces at night, and for being less aggressive to the environment. So, other practice suggested to Porto Alegre is "Energy efficient public lighting".

In Santa Maria, alternative sources of energy were not emphasized by stakeholders. On the other hand, they voted in the "Energy efficient public lighting" practice, with the purpose of replacing incandescent bulbs and implementing LED in streets and parks. This practice, in their opinion, would help the municipality to save energy and also reduce financial costs, which could be invested in long-term improvements.

A summary of the results of best practices selection is presented in Table 6. The implementation of tax incentives or discounts to promote sustainable projects would benefit all consumers addressed in the energy diagnosis, resulting in greater

Table 6 Summary of best practices chosen for each municipality

Municipality	Topics discussed in the meetings and workshops of lifelong learning	Selected practice(s)
Passo Fundo	• Incentive to the implantation and use of alternative energy sources in households and enterprises	Tax incentives or discounts to promote investments in sustainable projects
Porto Alegre	• Implementation of alternative energy sources for electricity generation in households • Replacement of conventional bulbs for LED ones	Tax incentives or discounts to promote investments in sustainable projects and Energy efficient public lighting
Santa Maria	• Replacement of incandescent bulbs and implementation of LED bulbs in public lighting	Energy efficient public lighting

sustainability through the development of efficiency practices, which can also contribute to the regulation of consumption and increased use of renewable sources.

Energy efficient public lighting as a practice to be developed contribute to reducing energy consumption in cities as a whole, but the benefits go even further: it also contributes to the increased sense of security and quality of life of the population.

Despite the need for planning to implement tax incentives or discounts, this practice could be carried out in a short-term period, while the implementation of more efficient public lighting, due to the demand for larger investments, tends to occur in medium and long-term periods.

6 Conclusions

For application of sustainability programs, the diagnosis and research for practices that are being applied worldwide are fundamental. In this sense, PRESUST-RS Energy work package intended to deepen the discussion on indicators and practices in the energy field. The results point to conclusions that can be used to propose measures of sustainability and energy efficiency in the cities under study and also others with similar characteristics. Experiences gathered in this project will be useful to people and public authority, in terms of lifelong learning and also suggested practices to be applied.

The energy diagnosis can contribute to the perception of priority sectors in the moment of defining which practices to use. In Santa Maria, the outstanding sector in terms of electricity consumption is the household, whilst in Porto Alegre the most remarkable is the trade sector and in Passo Fundo the industrial sector. Moreover, this diagnosis indicated positive results in terms of energy efficiency in regards to the share of renewable energy sources in electricity supply, but a more detailed study can lead to the conclusion that this is due to the country's great hydroelectric potential. There is a need for greater investments in renewable and alternative energy, which would contribute to greater energy security and less dependence on the hydroelectric source in times of water crisis, since the percentage of use of alternative energies such as wind and solar is still low.

In addition, the research and selection of sustainable practices led to the choice of energy efficient public lighting, through the use of LED technology and practices to encourage the implementation of sustainable projects by the population itself, such as tax incentives or discounts. That shows that the lifelong learning process with stakeholders tends to the preference for practices that are easier to be applied and, consequently, to have faster results and greater awareness of the city as a whole. These practices are also related to the results observed in the energy diagnosis, since their use will contribute to energy savings and increased use of renewable sources.

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Public Energy Policy in Cabo Verde

Luzia Mendes Oliveira

Abstract The need for a paradigm shift in development, from one based in fossil fuels to a more sustainable model, is increasingly pressing. Cabo Verde, as a Small Island Developing States (SIDS), has strongly invested in public policies for sustainable energy, with multifold objectives. This aim to reduce national Greenhouse Gas (GHG) emissions, however low, while improving security of supply, alleviating poverty, and achieving nationwide access to electricity. The development of sectors deemed crucial for the national economy. Therefore, the government launched a new strategy to achieve 100% of electricity production from renewable sources, until 2020 at most. Through quantitative methods, namely surveys, this research intends to better understand how knowledge, attitudes, practices and perceptions of citizens may influence the viability of such strategy. It concludes that, although the new policy has conditions to succeed, specific sociodemographic factors should be considered.

Keywords Energy transition · Public policy · Citizens · Cabo verde
100% renewable energy

1 Introduction

Many SIDS (Small Island Developing States) are working to implement sustainable policies of energy security and access (Douglas 2006; Jaramillo-Nieves and Del Río 2010). Energy sustainability has become a priority, and a wide range of Greenhouse Gas Emissions mitigation policies are being set up. These policies include investments in clean technologies and alternative energy production, as well as measures to encourage reduced consumption by way of both technology and more efficient energy saving practices.

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In Cabo Verde, the potential and importance of Renewable Energy (RE) was recognized very early in the country's development (Duarte Fonseca 1958). Since independence (1975), policy-makers have made it a governmental priority, especially in what concerns providing energy for bringing water to agriculture and for consumption (Morais 2014) and, later, with the goal of ensuring energy security. This goal was expressed and consolidated by successive governments. Considerable results became obvious starting in 2011 and the energy matrix now boasts 25% renewable energies (wind and solar) in the electricity mix. In 2008, the government set as one of its main energy objectives: to "*cover, approximately, 50% of the needs in electrical energy, until 2020, from renewable sources and have at least, one island at 100%*" (MEEC 2008). However, in 2014, a more ambitious strategy was adopted that proposed to increase the goal from 50 to 100% by 2020. In 2015, this goal culminated in the preparation of three instruments (República de Cabo Verde 2015): Renewable Energies National Action Plan (RENAP—2015–2020/2030), Energy Efficiency National Action Plan (EENAP—2015–2020/2030) and the Action Agenda for Sustainable Energy for All (AASE4ALL—2030).

The feasibility of this strategy is subject to several conditioning factors: (a) the institutional, financial and technical conditions, (b) the time required for the transition process and (c) the willingness of the population and other stakeholders to collaborate. This chapter will explore the latter issue in order to understand to what extent citizens' knowledge, attitudes, practices and perceptions may influence the viability of this strategy "Cabo Verde 100% renewable in 2020".

This work starts from the principle that one of the factors limiting the feasibility of the current strategy is the degree of collaboration of every energy consumer and their attitudes toward consumption. It remains to be seen if these citizen-consumers are prepared to contribute. Citizen participation also requires prior knowledge of the importance of this strategy and its roles to play. It also requires a knowledge of the best attitudes and practices that should be adopted. Issues related to reducing consumption by increasing the efficiency of equipment and appliances are considered essential, namely: What are the attitudes toward the purchase? What are the most common practices? What measure do citizens should be adopted by decision-makers so as to support the savings? Are they willing to replace their equipment or appliances with more efficient ones? It is also necessary to understand if citizens are willing to accept the installation of the infrastructure needed for energy production.

It is expected that the goal of greater energy efficiency will be met. One of the main current problems of Energy Efficiency (EE) in Cabo Verde relates to technical and commercial losses in the production, transportation and commercialization system that are as high as 24.4% (ELECTRA, SA 2015). One of the measures to solve this problem has been fighting against illegal electricity connections. It is important to raise citizen awareness about illegal connections and enlighten them about how each person might contribute to the fight against this problem.

Existing studies of energy sustainability in Cabo Verde have dealt with: technical solutions for improving the usage of RE; synergies between the water and energy sectors; proposals to use RE to supply remote locations (Fonseca Duarte

2010; Segurado et al. 2010; Dias 2010; Monteiro 2012). However, none of them has focused on the goal of achieving 100% renewable source in all 9 islands and neither have they included an investigation into public opinion as an important element in implementing Public Policy (PP). This study attempts to fill this gap.

1.1 State of the Art

The lack of fossil fuels in most SIDS, combined with potential sources of RE (Timilsina and Shah 2016) constitute good opportunities for RE implementation. However, constraints exist such as: difficulties in establishing production infrastructures to scale; the lack of technical capacity; the continued use of fossil fuels for energy production; lack of funding for investment; the lack of institutional structures and regulatory approaches; feeble initiative for replicating successful projects and even limitations in technology transfer (Weisser 2004; Wolf et al. 2016). These obstacles come together to make it difficult to take advantage of this potential. Therefore, it is imperative to overcome these barriers to changing from an energy development paradigm based on fossil fuels to a more sustainable one. Such change implies a transition that is crucial for any system transformation (Roy 2005; Geels 2002). Therefore, energy sustainability in production and consumption calls for a transitional process in which several authors suggest socio-technical transformation regimes (Sovacool 2009; Gross and Rudger 2015) which include changes to user practice, regulations, infrastructure and equipment. Meadowcroft (2009) points out that, in transition theories, main stakeholders are involved in defining the future vision so that each one might understand the pre-defined goals. They also highlight the fact that the experience of transition demands new social and technological practices. It is in these new practices that final consumers are invited to play a role, adopting best attitudes to reduce energy consumption. This implies acquiring appropriate knowledge on the one hand, and, on the other, creating the economic conditions and the regulatory and institutional framework, while promoting measures that might encourage such practices.

EE policy is an essential and complementary to RE investment in this transition process. Some barriers range from behaviors to attitudes toward consumption, the perceptions of investment risks or even the gaps in information and incentives (Trianni and Cagno 2012). Thus, Chai and Yeo (2012), have recommended that policy makers approach to these barriers in a holistic manner.

In all PP, energy, including RE and EE, need to be legitimized and accepted by the beneficiaries so as to avoid conflicts of interest during implementation. Even during the follow up phase of a specific PP, such legitimacy can facilitate the process of ownership by the community, oftentimes depending on a process of exchange between the society and the government (Riege and Lindsay 2006).

Of particular interest regarding RE issues is the acceptance of the infrastructure by the communities, since their installation is often controversial. If RE is to continue to grow, policy makers, economic agents, citizens and the general society

must express their support and contribute to its implementation (Delicado et al. 2015). Additionally, regarding acceptance and legitimacy, claim that, the deeper the base of knowledge on which the (PP) are built, the greater is the likelihood of success (Riege and Lindsay 2006). Following Wallner (2008), PP initiatives are tangible manifestations of conscious decisions from governments on behalf of their citizens. As such, governments should work to ensure that their instruments, ideas and implementation strategies are aligned effectively with the dominant attitudes of populations.

2 Methodology

The sampling frame of this research is Santiago Island, which, according to the 2010 census, had a population of around 273,912 inhabitants. The sample included 806 respondents in total and represents around 0.3% of the island's population. The representativeness was calculated for a significance level of 99% and for 5% of error margin. According to the sample size calculation, to such a level of significance and margin of error, the minimum size would be 664 questionnaires.

The sample selection considered the following criteria: sociodemographic characteristics (gender, age group, educational level, place of residence, economic activity situation) and places without electricity. There were some deviations related to the sample, for this reason the stratified sampling technique does not apply.

The questionnaires were applied between July 7 and 8, 2016 and were preceded by pretesting with 20 people. Later, we analyzed and discussed the results according to the 4 thematic axes that form part of the structure of the questionnaires: (1) RE and EE knowledge; (2) attitudes and practices of EE and opinion about the measures; (3) the Cabo Verde 100% renewable strategy in 2020; and (4) illegal electricity connections.

In order to ascertain the relationship of dependence or not between the different variables, we performed the appropriate intersections between the variables, always supported in the theoretical framework and the questions that guided this research.

We used SPSS, 23.0-Windows, primarily using descriptive statistical techniques and, subsequently, the inferential statistics to validate the hypothesis. The level of significance to accept or reject the null hypothesis was $(\alpha) \leq 0.05$.

The tests performed were: Chi-square test of independence for qualitative variables; Fisher for cases in which there were variables with two levels (2×2 tables); Chi-square test of adjustment for a distribution to obtain a theoretical distribution; Anova One-way when comparing more than two groups in dependent variables of ordinal type, but when treated as quantitative variables. To identify the groups responsible for the differences, we used the multiple comparison test posteriori of the Tukey test with a 5% probability level.

3 Results and Discussion

3.1 Knowledge of RE and EE

There is a need to capacity building of actors since long-term PP based on participatory processes and social learning requires certain qualities of actors' empowerment (Avelino 2009).

The results about knowledge indicate that the vast majority of respondents had heard both about RE and EE (Figs. 1 and 2). However, the proportion of those familiar with RE was greater than that knowledgeable of EE (88 vs. 64%). The order of relevance of the sources of information about both RE and EE, began with the media, followed by school, and finally the community.

About 90% of those who had electrical energy at home (Fig. 3) and had various appliances at home (Fig. 4). The appliances most often used were: television, refrigerator and iron (Fig. 5). Most respondents claimed not to know the energy consumption of their appliances (Fig. 6). They imagined the greatest consumption to be: refrigerator, iron, washing machine and Television (TV) (Fig. 7).

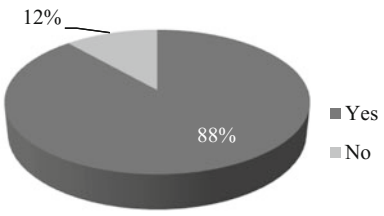


Fig. 1 Heard about RE

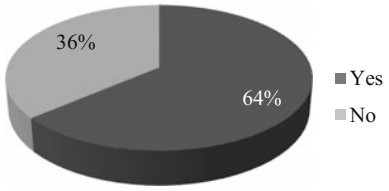


Fig. 2 Heard about EE

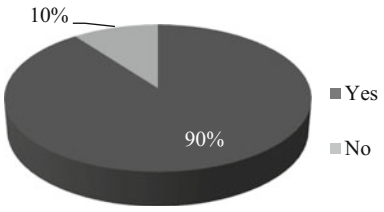


Fig. 3 Home electricity

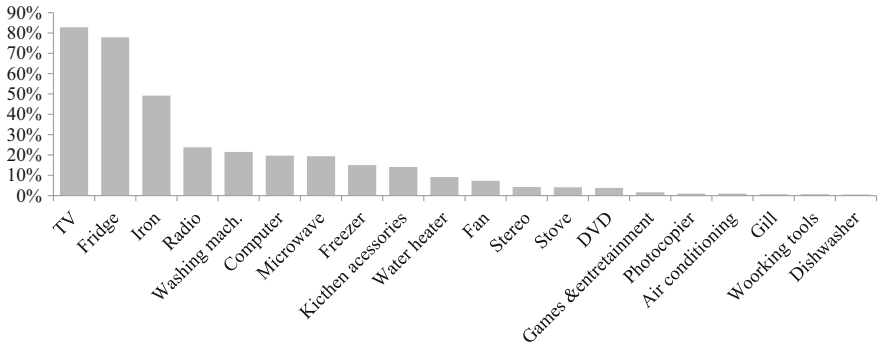


Fig. 4 Ownership of appliances

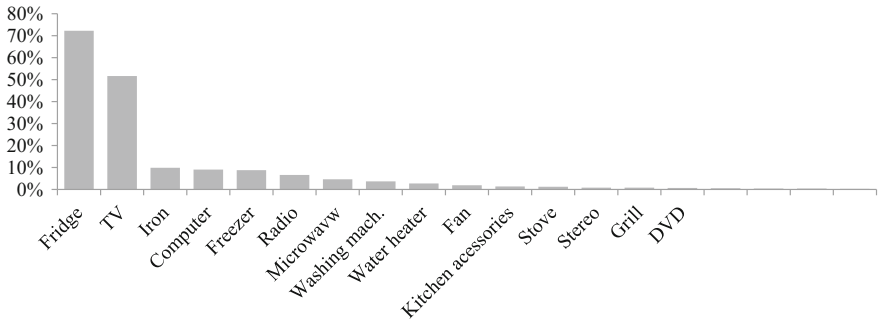
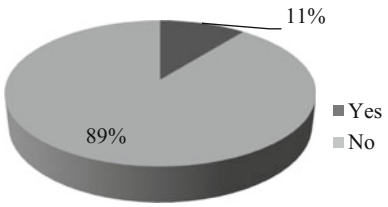


Fig. 5 Appliances used most frequently

Fig. 6 Knowledge of energy consumption of appliances



The knowledge about RE varied with the level of education, age group, area of residence, and whether they had electricity at home.

Educational Level there was a significantly higher proportion of individuals with secondary and higher education who said they had heard about RE (Fig. 8).

Age Group there was a significantly higher proportion of subjects in the age group 15–25 years old who said they had already heard about RE (Fig. 9).

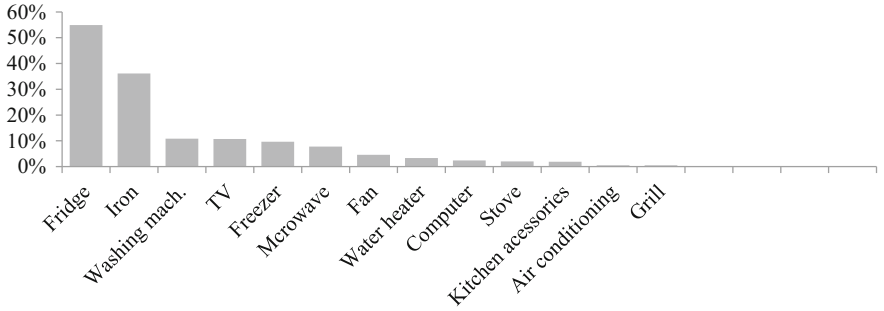


Fig. 7 Household appliances wich consomes more

Fig. 8 Heard about RE/educational level

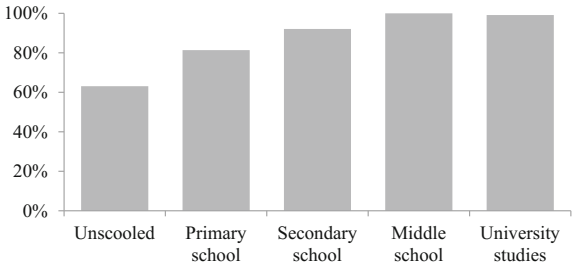
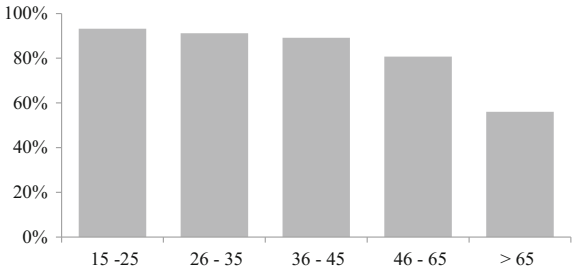


Fig. 9 Heard about RE/age group



Place of Residence there was a significantly higher proportion of urban residents who claimed to have heard about RE (Fig. 10).

Having Home Electricity Respondents with electricity at home were significantly more likely to have heard of RE than those without power (Fig. 11).

Most of the respondents were familiar with the concept of EE and the proportion varied with education level, age, place of residence, and whether they had home electricity.

Educational Level A significantly higher proportion of individuals with higher education reported that they had heard about EE (Fig. 12).

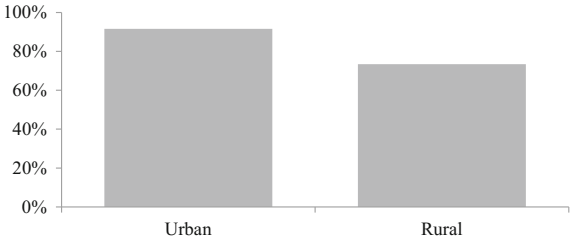


Fig. 10 Heard about RE/place of residence

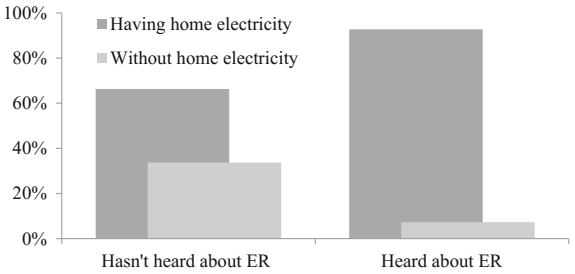


Fig. 11 Having home electricity/heard about ER

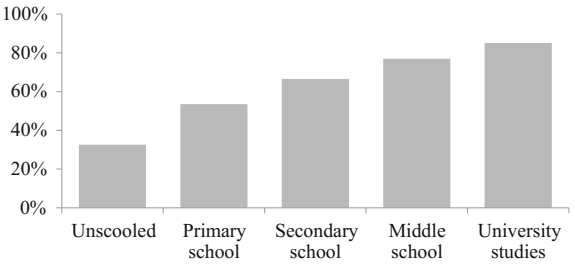


Fig. 12 Educational level/heared about EE

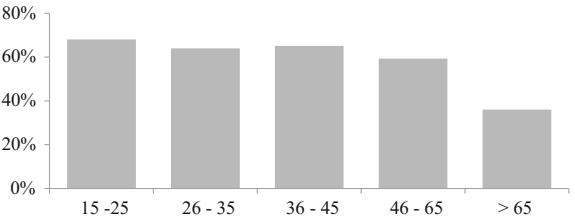


Fig. 13 Age group/heard about EE

Age Group There was a significantly higher proportion of older subjects (+65) who said they had no knowledge of EE (Fig. 13).

Place of Residence There was a significantly higher proportion of urban people (65.4%) who said they had heard about EE (Fig. 14).

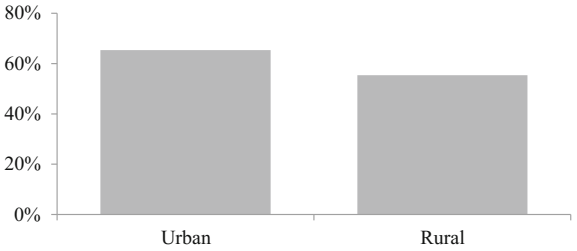


Fig. 14 Resident population/having home electricity

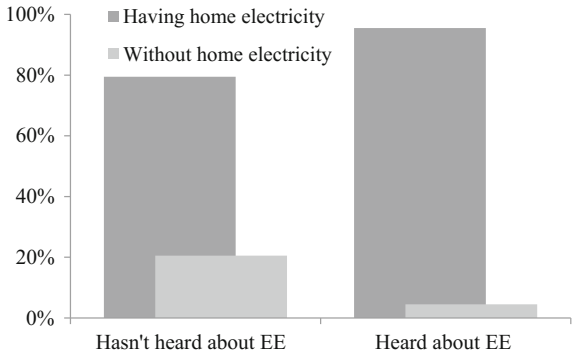


Fig. 15 Having home electricity/heard about EE

Having Home Electricity Those respondents with home electricity were significantly more likely to have heard about EE. These results reinforce others indicating that the primary source of information about RE and EE is the media, mainly TV. Typically, in communities still lacking electricity this device is rarely present (Fig. 15).

3.2 Attitudes, Practices of EE and Opinion of the Measures

As for EE practices, only 16% reported that they had done nothing, choosing "They haven't done anything" (Fig. 16).

Those who were already carrying out some of these practices, more than 60%, already "*used low consumption light bulbs*", 56% already "*turn off appliances* when *they are not in use*" and 36% already opted to "*use appliances less often*".

Other practices used to save energy were: "*taking advantage of natural lighting*, *opening the refrigerator less frequently*, *not using the microwave*, *and turning devices down to the minimum*".

Most respondents had already adopted best EE practice and those varied with: place of residence and employment status. Neither age nor gender differences were statistically significant.

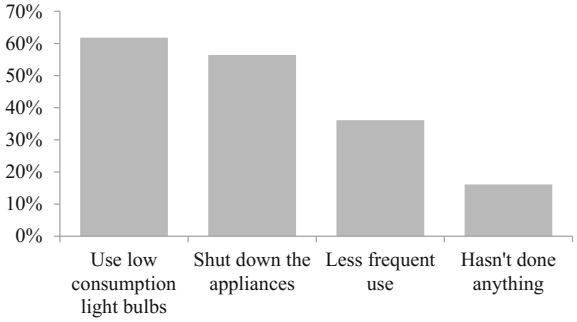


Fig. 16 Practices to reduce consumption

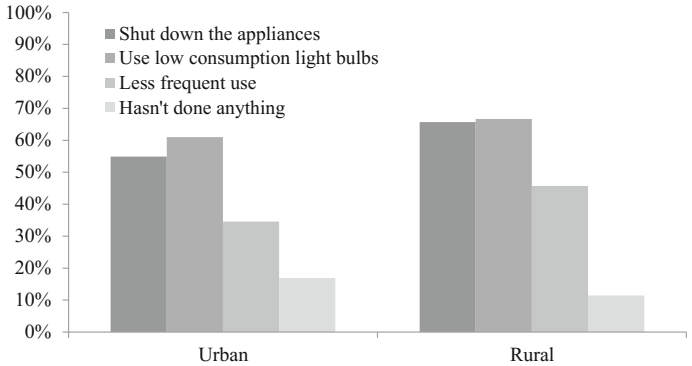


Fig. 17 Place of residence/practices

Place of Residence Respondents living in urban areas were the least likely to "turn off the appliances" and the least likely to "frequently use the appliances" and the difference was statistically significant (Fig. 17).

Considering these results, it is necessary to take measures to strengthen awareness in urban areas. This result is inconsistent with those observed in previously where urban residents stated that they had heard more about EE. When it comes to habits, however, the results demonstrate that they are the least active. One can deduce that the information on EE transmitted in urban areas has not produced much effect.

Employment Status the use of "low consumption light bulbs" is more common by those actively working and by retired people, with statistically significant differences (Fig. 18). We found that there was little domestic use of "low consumption light bulbs". It is also in this class that there was a higher level of use of EE practices with respondents saying, "They haven't done anything" to reduce energy consumption, which it is troubling to say. More EE practices were expected in this category, because they usually deal daily with a variety of appliances and mostly perform tasks at home that would be potential targets for EE practices.

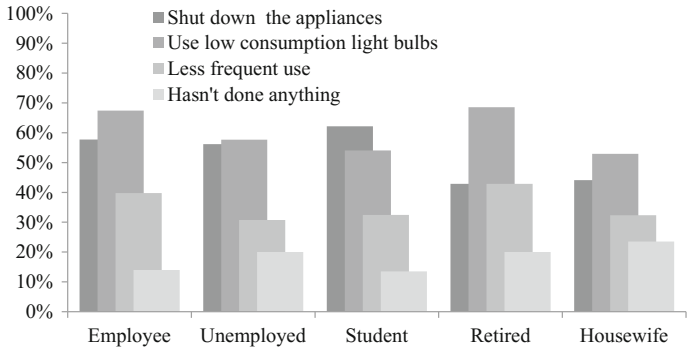
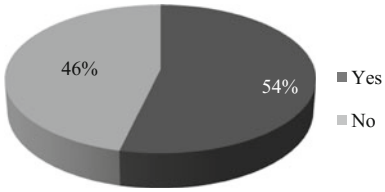


Fig. 18 Employment status/practices

Fig. 19 Preoccupation at purchase



It is also noted that retired people were those who least "*used the appliances*" as a way of saving energy, and students were those who most said they "*turned off the appliances when they aren't in use*".

This result may also reflect EE campaigns by public services and some private services to replace light bulbs. According to (Truninger 2015), due to the intrinsic and complex relationships between practices and elements that transcend individual decisions, it is not enough to promote change only at the individual level. The author suggests that the range of tools for political encouragement should not be limited to a single instrument. Rather, a range of tools should be utilized, mixed and adjusted to the context and configuration of elements to be altered. Also suggests that the range of actors responsible for fostering change be diversified.

The higher percentage of students who answered that they "*turn off the appliances*" when they aren't in use. This reflects the result of the EE consciousness raising activities in schools, both by public authorities and by non-governmental organizations. As for retirees, the low value of the monthly pensions may be a motivation for them to rationalize consumption.

Attitudes toward purchase assesses people's concern when buying appliances about how much energy they expend. We found that there was almost a balance between those who said yes and who said no (Fig. 19).

The criteria used in the purchase by degree of importance: the "brand" and "lowest energy consumption" were "very important" criteria and "recommendation by others" was rated as "not at all important" (Fig. 20).

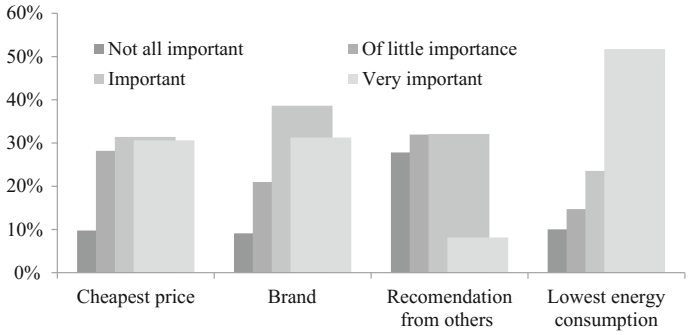


Fig. 20 Criteria used in the moment of purchase/degree of importance

Table 1 Reasons for not paying attention to EE at purchase

	Frequency	Percentage
Didn't know that this aspect was important	179	50.0
Don't give importance to this	142	39.7
Both	37	10.3
Total	358	100.0

Of those who did not bother to find out how much energy the appliance consumes (Table 1), most justified their lack of attention saying that they "didn't know that this aspect was important", 39.7% said that they "don't give importance to this" and 10.3% indicated both reasons.

Most respondents claimed to want to know what the energy consumption of the device was at purchase.

Respondents' attitude towards equipment purchase depends on the degree of importance they attach to certain criteria which, in turn, is related to employment status and educational level.

Employment Status versus "Brand" the "brand" is the most important criterion in the purchase of appliances for those who have a job, as opposed to retired people or housewives, and these differences were statistically significant (Fig. 21). So, the economic power of those who are actively working is usually greater than that of housewives. People who are not often remunerated for their work have the management of the family monthly budget under their control, a fact which might justify this gap in the preference of this criterion in the purchase of equipment. The "brand" is usually associated with the "price" and we usually think that the best "brands" are the most expensive.

Educational Level versus "Brand" the "brand" is taken as a significantly more important criterion in the purchase of appliances for those subjects with secondary studies than for those who are unschooled or with just primary level education. The difference between those with higher level and unschooled is also statistically significant (Table 2).

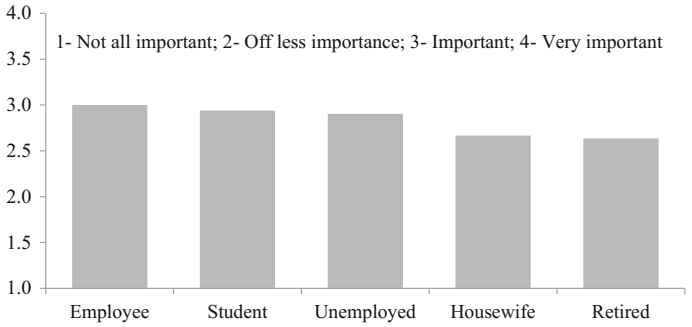


Fig. 21 Employment status/brand

Table 2 Tukey test

Educational level	N	Subset for alpha = 0.05		
		1	2	3
Unschooled	43	2.56		
Primary school	213	2.80	2.80	
Secondary school	356	2.94	2.94	2.94
University studies	111		3.15	3.15
Middle school	25			3.28
Sig.		0.149	0.216	0.238

Table 3 Tukey test

Educational level	N	Subset for alpha = 0.05	
		1	2
Unschooled	43	2.81	
Secondary school	356	3.14	3.14
Primary school	213	3.15	3.15
Middle school	25		3.36
University studies	111		3.41
Sig.		0.341	0.576

These results point out that unschooled respondents do not know much about the existing brands in the market, nor do they associate this criterion with price. The result may also be connected to economic power; the less educated are usually those who have less purchasing power, as they are most frequently unemployed.

Educational Level versus Lowest Energy Consumption the "lowest energy consumption" is a significantly more important criterion when buying appliances for individuals with higher education and with medium education than is the case for the unschooled (Table 3).

This may mean that people with higher levels of education are more aware of the importance of EE in conjunction with the fact that school represents the second

most important place where one hears about EE. It is also a privileged place for implementing EE campaigns.

Educational Level versus "Lowest Price" the "lowest price" is a significantly more important criterion in the purchase of appliances for individuals with primary level studies as opposed to those with higher level and secondary level (Table 4).

Therefore, for people with low levels of education, the most important issue to them is price.

Since campaigns have direct impacts on people, it is important to assess how they affect actors at various levels of policy implementation. This implies considering the behavioral assumptions underlying the design and selection of policy instruments (Avelino 2009). According to Schneider and Ingram (1993), people often either lack incentives or the ability to take the necessary measures or they disagreed with the implicit means or ends of PP.

Respondents opinions about the measures that should be undertaken by institutions in order to encourage EE choices amongst consumers suggested that the situation is not favorable to monopoly in energy sector, since the majority opinion demands a "more competition between energy suppliers" (Fig. 22).

Other measures listed were: combatting energy theft, fighting unemployment, investing in ER, improving regulations, reducing/abolishing fees, and awareness raising about consumption.

3.3 Strategy "Cabo Verde 100% Renewable in 2020"

El Hierro in the Canary Islands, Spain was the pioneer island to achieve 100% renewable electricity provision in 2014. On June 2014, participants at the RENISLA Global Forum on the island of El Hierro, UNESCO's biosphere reserve, recognized that 100% renewable is possible and they made a declaration, agreeing that: the "*transition to 100% renewable energy requires the full engagement of the institutional frameworks and governments*" and "*this shift in the energy culture requires a grassroots approach, where citizens and local communities come first*" (*go100re*).

Table 4 Tukey test

Educational level	N	Subset for alpha = 0.05	
		1	2
University studies	111	2.59	
Secondary school	356	2.76	
Middle school	25	2.88	2.88
Unschooled	43	2.98	2.98
Primary school	213		3.03
Sig.		0.072	0.576

3.3.1 Knowledge and Agreement

Our results showed that approximately 53% of respondents said they were aware of the strategy (Fig. 23).

Respondents' educational level and age influenced their knowledge about the issue and in accordance with the goal of this strategy.

Educational Level There was a significantly higher proportion of individuals with higher levels of education who said they had heard about the strategy. Therefore, for rising levels of education, there were increased numbers of respondents who had heard of the strategy (Fig. 24).

Age Group There was a significantly higher proportion of individuals in the 15–25 age group who said they had not heard about the strategy (Fig. 25). This seems a bit worrisome and suggests that younger people are not interested in this PP. It is also worth considering that most of them are not yet responsible for paying bills.

The degree of agreement with the strategy among the respondents was low (38%). Only 14% agreed with the strategy and nearly half did not have an opinion (Fig. 26).

The agreement with the target of this strategy depended on respondents' educational level.

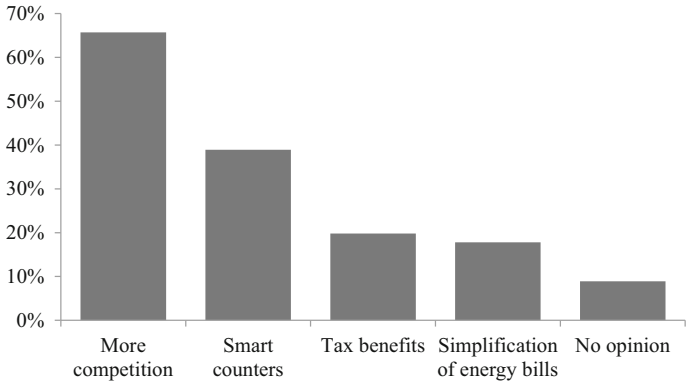
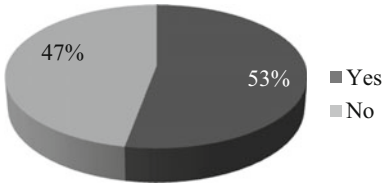


Fig. 22 More effective measures to reduce energy bills

Fig. 23 Heard about strategy



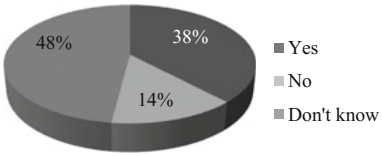


Fig. 24 Agreement with the target

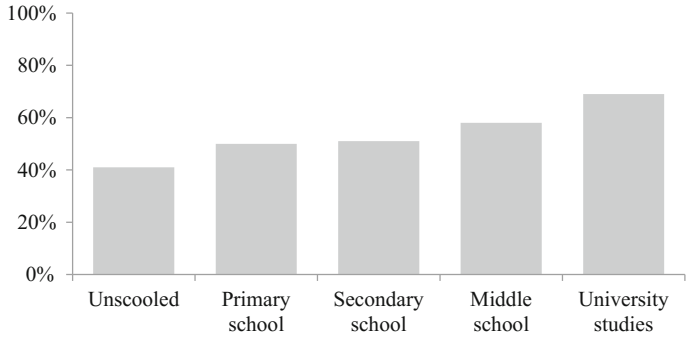


Fig. 25 Educational level/heard about strategy

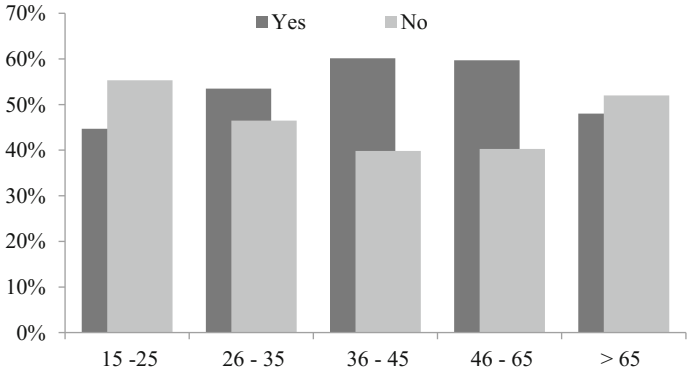


Fig. 26 Heard about strategy/age group

Educational Level there was a significantly higher proportion of individuals with higher levels of education who disagreed with the "Cabo Verde 100% renewable in 2020", and there was a higher number of participants at the unschooled and primary level who lacked an opinion about the goal (Fig. 27). This result seems predictable. It was expected that the subjects with more education would be better informed about the feasibility of this goal and the largest constraints upon it. In contrast, unschooled respondents and those with just a primary education, who, while not

giving an opinion, demonstrated that they had not received sufficient information to allow them to make judgment regarding such a goal.

When giving their opinions about some aspects of the strategy, 72% (those who either answered "agree" or "totally agree") said that it is "*beneficial for future generations*" (Fig. 28). When asked whether "*the country is prepared to achieve this target*" 46% had no opinion. Only 23% (those who answered "disagree" and "disagree totally") were in agreement (Fig. 29).

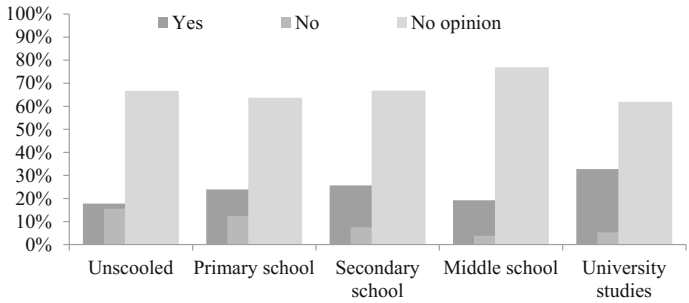


Fig. 27 Agreement with strategy/educational level

Fig. 28 The target is "*beneficial for future generations*"

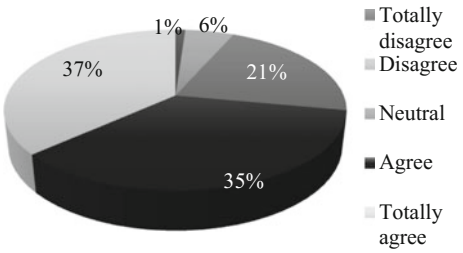
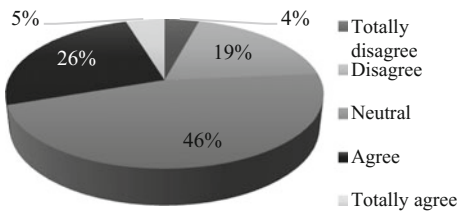


Fig. 29 "The country is prepared to achieve this target"



3.3.2 Willingness to Collaborate in the Implementation

When asked if they would be willing to pay higher electricity bills in order to meet the goal of Cabo Verde achieving 100% goal, most of the respondents answered negatively. Only 41% ("Agree" or "Totally agree") were willing to pay and 25% were undecided (Fig. 30). In contrast, there was greater willingness to replace their appliances with more energy efficient models (Fig. 31). The most popular incentive for achieving this end was to receive the devices for free, followed by a "*discount on energy bill*" and the "*discount at purchase*" (Fig. 32).

The willingness to pay more for energy services depended on place of residence.

Place of Residence The proportion of individuals willing to pay more for energy was significantly higher for urban versus rural residents (Fig. 33). Usually, people who live in urban areas have better economic conditions because there are more opportunities for employment and other forms of income, and they will be better able to pay. Another fact is that rural residents are less well informed about this issue, in particular regarding its advantages, which make it difficult for them to be willing.

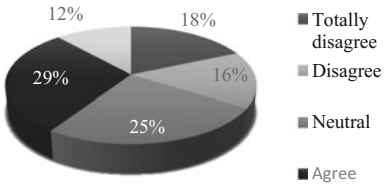


Fig. 30 Willing to pay more

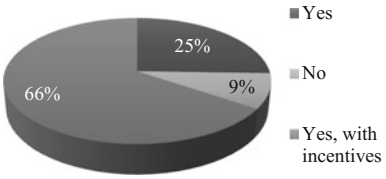


Fig. 31 Willing to replace appliances

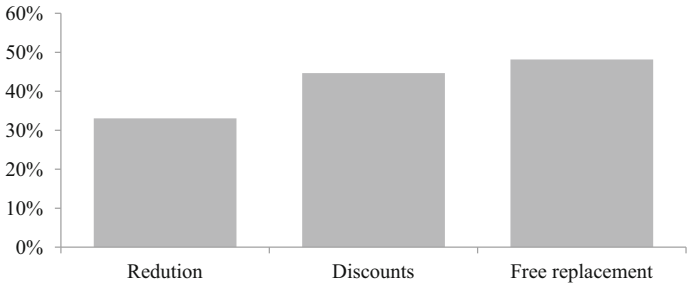


Fig. 32 Type of incentives

Age Group There was a significantly higher proportion of individuals aged >65 years who claimed to be willing to pay more for energy to achieve this target (Fig. 34).

It was the youngest two cohorts (15–25 and 26–35) who expressed the strongest objections to paying more for electricity. For older groups, the opinions reversed themselves to the point of being statistically significant for those 65+ years of age.

3.3.3 Infrastructure Implantation Acceptance

Solar power was the most popular form of infrastructure, followed by wind energy. The option of waste incineration received the highest level of rejection (Fig. 35).

The reasons cited for rejecting both solar and wind energy power were primarily related to concerns that they may have "negative impact on the environment" and "on public health". Public health concerns were the most commonly cited reasons for rejecting the incinerator (Table 5).

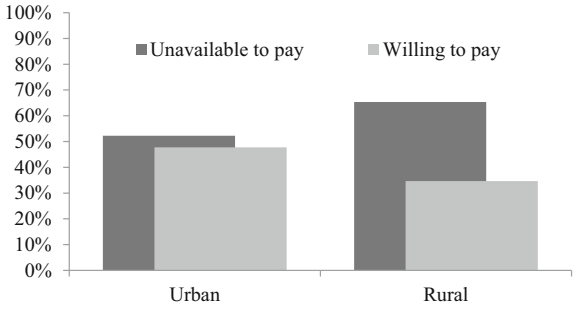


Fig. 33 Place of residence/availability to pay

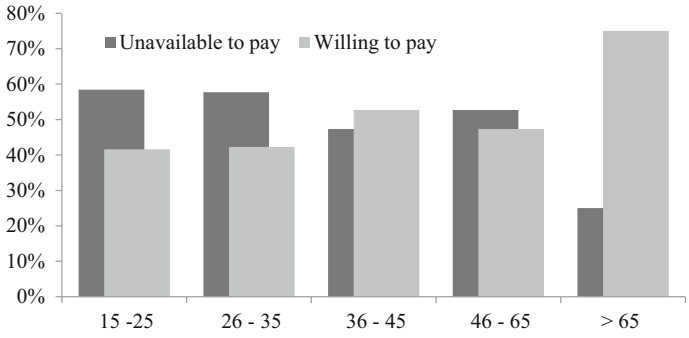


Fig. 34 Willing to pay more/age group

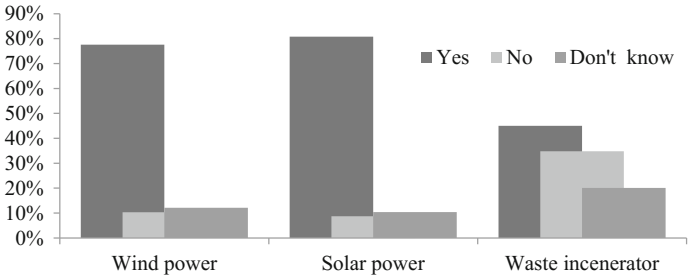


Fig. 35 Infrastructure acceptance

Table 5 Reasons for rejection

	Reasons		
	Negative effects on the environment	Affects public health	Both
Wind power	46.1	22.4	13.2
Solar power	39.7	29.4	14.7
Waste incinerator	31.7	43.6	3.1

The implementation of this strategy would require building production infrastructure for a wide range of technologies, a fact which would require the acceptance by the resident populations in nearby communities. Hence the citizens need to be able to defend their multiple interests that might be at play, which is only possible with at least the knowledge of the environmental impacts associated with each. These results showed that there is broad acceptance within the respondents both for solar and wind energy production facilities (81% and 78%, respectively), while for biomass (waste incineration) the acceptance is low (45%). In this case, it can also be stated that this strategy will not run up again great resident resistance since the technologies already identified as more technically and economically viable are precisely solar photovoltaic and wind power. This result is also similar to a study of community acceptance of large-scale solar energy installations in Morocco, when founds a high level of community acceptance. Such a result is largely due to expectations of positive or at least non-negative environmental impacts (Hanger et al. 2016).

3.4 Attitudes Towards Illegal Electricity Connections

Regarding the reasons for illegal electricity connections, most cited "because energy price is becoming more expensive" *followed by* "lack of money to pay bills"*, and* "bureaucracy and slowness on the part of responsible entities" (Fig. 36).

Most respondents knew about the law that penalizes people who illegally connect to electricity lines (Fig. 37). *As for measures to combat illegal connections,*

58% *suggested* "denouncing infractions", 48% "advising others not to do that" *and* 9% *suggested* "giving help for the legalization" (Fig. 38).

"Lack of electricity in the communities" was the justification for illegal electricity connections.

There was a higher proportion of subjects without electricity at home who thought that the reason that led people to illegally connect to power lines was the "lack of electricity in the communities" and the difference was statistically significant (Fig. 39).

This result attests to the state of illegal connections in the country. In almost all small communities where there is a medium or high voltage network without a binding extension, residents connect illegally, thus providing electricity to their homes and with inappropriate material. In addition to representing a commercial

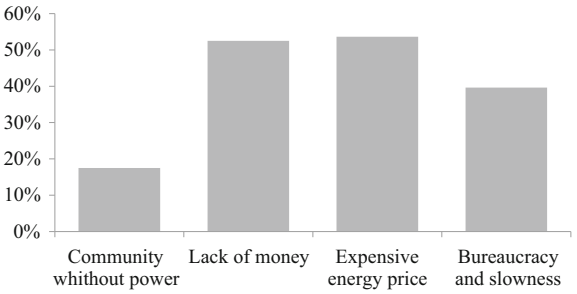


Fig. 36 Reasons for illegal connections

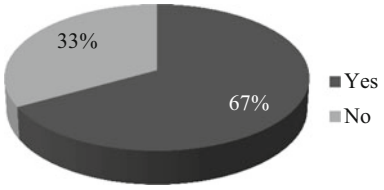


Fig. 37 Knowledge about the law

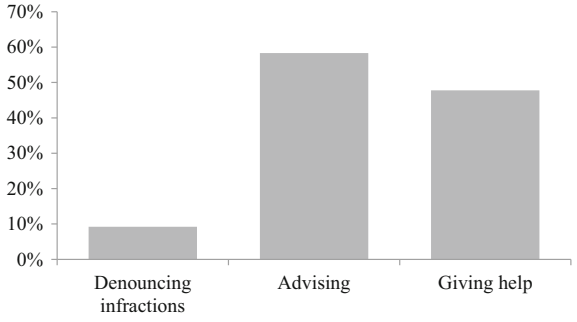


Fig. 38 Reasons for illegal connections

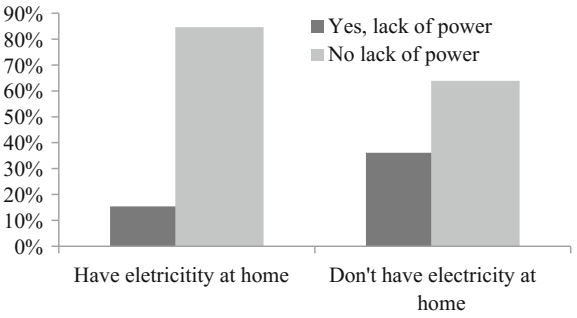


Fig. 39 Reason "Lack of electricity in your communities"/electricity at home

loss to companies and causing technical problems in transmission and distribution system, this illegal act has claimed the lives of several people who, without having noticed the existence of badly placed electrical wires, have died from electrocution.

Clandestine connections are also, frequent in urban spaces, where they arise from informal building patterns in the city (Roy 2005). Many homes are built surreptitiously, thereby failing to meet the required standards and therefore would fail to receive authorization for their legal connection.

4 Conclusion

Respondents' knowledge of RE and EE is good. If that was all that was needed, the 100% Renewable Strategy, even if it is implemented in 2020, it will not have any major problems. However, some differences related to the sociodemographic characteristics should be addressed. Information and awareness among people with lower educational levels should be improved as should happen with older groups, among rural residents and even those in communities without electricity. The vehicles for transmitting information must be diversified. It is true that the media has played a leading role in this process, but it is necessary to go into the field and carry the message to people in their communities, especially the rural ones.

Regarding EE attitudes and practices, the implementation of this strategy will be able to count on a good foundation. Although most of the respondents were not aware of the consumption of their appliances, a reasonable number did take this information into account upon purchase. This attitude seems to be an important a point of departure. However, there are precautions to be taken, namely: the promotion and dissemination of information regarding the consumption of appliances; carrying out initiatives to improve the economic situation of the population, so that they might avoid the overreliance on low prices as the main purchasing criterion. These measures should be combined with another: a campaign to withdraw less efficient equipment from the market and/or to discourage the sale of less efficient devices. Insofar as EE practices are concerned, awareness in urban areas must be enhanced. This responsibility should be shared by other actors in the general society

and not merely governmental ones. It also suggested specific campaigns be developed that target housewives.

In conclusion, when asked what kind of support would aid them in reducing energy consumption, respondents most commonly answered "*more competition between energy suppliers*". The issue of the energy production monopoly should be afforded much attention and the regulatory entity should meet its obligation to represent fairly consumers' interests.

Respondents' perception about the strategy is not good. Although the majority recognize the importance for future generations, a good number disagrees or has no opinion regarding the conditions for implementation. This leads us to suggest the need for a greater awareness and socialization, especially among those with lower educational level and young people.

A positive aspect is that most respondents are willing to replace their appliances and accept the building of infrastructure, while there is resistance to paying more, particularly among older people and rural residents.

Illegal connections to electricity is a problem for EE and consequently serves as an obstacle to meeting the goal, and they must be resolved. Improving living conditions by creating more jobs and improving the performance of the energy company by reducing bureaucracy and increasing efficiency, seem to be essential strategies. Most respondents are aware of this issue. They said that they were aware of the legislation in force and were willing to cooperate in combating the problem. However, the reasons behind this practice must be resolved. Our suggestions include: creating a tax/subsidy that might protect the most economically fragile consumers; promoting mechanisms aimed at increasing family incomes; and promoting autonomous systems of electricity provision to communities in need that rely on renewable energies.

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Erratum to: Participatory GIS for Urban Sustainability and Resilience: A Perspective of Social Learning and Ecology of Knowledge

Carolina Monteiro de Carvalho and Leandro Luiz Giatti

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