Shikui Dong
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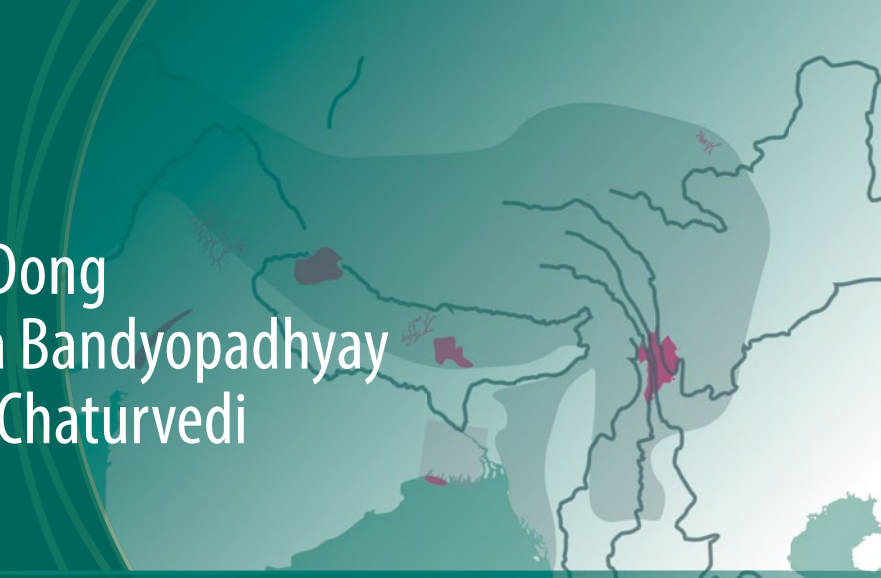
*Editors*



# Environmental Sustainability from the Himalayas to the Oceans

## Struggles and Innovations in China and India

Springer

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ISBN 978-3-319-44035-4 ISBN 978-3-319-44037-8 (eBook)
DOI 10.1007/978-3-319-44037-8

Library of Congress Control Number: 2016954311



Printed on acid-free paper

This Springer imprint is published by Springer Nature
The registered company is Springer International Publishing AG
The registered company address is: Gewerbestrasse 11, 6330 Cham, Switzerland

*To our children and grandchildren*
*and*
*the memory of Prof. Rajni Kothari*

# Foreword

The future of the world depends on our ability to better understand and creatively engage with increasingly complex environmental issues. ***Environmental Sustainability from the Himalayas to the Oceans: Struggles and Innovations in China and India*** is a must-read collaborative work on the importance of histories, contestations, theories, and innovative ideas in the study of environments. Considering the severe paucity of sound scholarship with an explicit focus on China and India, this book provides critical multidisciplinary insights into the significance of social innovations in addressing daunting environmental challenges. By bridging the gap between the scientific and cultural understanding of the natural environment and simultaneously placing the "twin-civilizations" of China and India at the center of the inquiry, the book offers a new framework for the study of complex environmental issues. At the same time, the book invites us to rethink the traditional separation between the social and ecological and masterfully emphasizes the need to study environmental challenges from multiscalar, interdisciplinary perspectives. In doing so, the book brings to life alternative narratives and opens the possibility for the emergence of new imaginaries for a more just and sustainable future.

What also makes this work unique is the nature of collaboration amongst the authors. The book is the product of a highly engaged dialogue, first initiated in 2010, between the three lead authors, Shikui Dong, Jayanta Bandyopadhyay, and Sanjay Chaturvedi. Along with Nidhi Srinivas and Victoria Marshall, all of the authors were part of the India China Institute Fellowship Program entitled "Social Innovation for Sustainable Environments."

During the ICI Fellowship (2010–2012), generously funded by the Starr Foundation and convened by the India China Institute at The New School, a university based in New York City, the fellows met periodically and conducted research in India, China, and the United States. In the process, the professional and interpersonal relationships enabled them to better manage linguistic, political, cultural, and disciplinary boundaries. Considering the short duration of the ICI

Fellowship Program, the fellows were not required to produce a book. However, this volume became the natural outgrowth of precisely the type of collaborative environment that the program aimed to foster. The fellows' passionate interest in the question of social innovation for sustainable environments, along with the friendships they forged, led them to compile this edited volume through their own initiative.

The structure of the book uniquely connects various ideas, debates, and research findings by interweaving the joint exploration of China and India with the subject of environmental sustainability. It is the unique multidisciplinary dialogue between the different chapters that most powerfully shows why the "twin-civilizational" framework matters. For example, the two chapters on the historical overview of the environment in China (Dong) and India (Bandyopadhyay) could very well be stand-alone chapters. Yet, they could also be read together or in conjunction with the other chapters. Similarly, Jayanta Bandyopadhyay's chapter on the restoration of the two mother rivers, the Yellow and the Ganges, is complemented by Shikui Dong's essays on the Himalayan grasslands and Himalayan transboundary biodiversity, and Sanjay Chaturvedi's essays on the micro-geopolitics of resistance and social innovations in the coastal mangrove forests in China and India. Beyond the outstanding merits and masterful scholarship of each individual essay, it is their mutual complementarity that allows for recognition and appreciation of the multiscalar interconnectedness of Asian ecologies. Through these carefully designed works, the authors successfully demonstrate the need for a new intellectual frame around the notion of the "Himalayan Sphere." This brilliantly developed new intellectual frame, highlighting the interconnectedness between the mountain and the coast, the Himalayas and the deltas, is bound to open profound new possibilities for thinking about environmental issues and challenges in the region.

Linked to these conversations from an alternative perspective are the other two chapters. Srinivas's chapter on environmental grassroots partnership and potential for social innovation explores how local management actions strengthen ecosystem responses to crisis. Through a careful discussion on innovations at the grassroots in China and India, Srinivas helps us better understand the politics of social innovation. In the final chapter on designing delta interactions focused on the Ganges-Brahmaputra-Meghna Delta and the Yangtze-Qiantang Delta, Marshall argues about the importance of village city systems in the deltas, which are intimately connected to the Himalayan sphere. Her brilliant drawings, presented through two new inter-referenced drawing methods, enable new ways of understanding complex urban ecosystems and debates surrounding the limits of eurocentric urban design practices.

All in all, I am convinced that this book is an important resource for students, scholars, and policy makers alike. By sheer coincidence, I am privileged to have had the honor and opportunity of convening and supporting the work of these five brilliant scholars. I am certain that their collaborative undertaking will inspire new imaginaries for positive social and ecological changes, and I am glad that the India China Institute and The New School played a small part in this exciting project.

Ashok Gurung
Senior Director, India China Institute
Professor of Practice, Julien J. Studley Graduate Program
in International Affairs, The New School,
New York, USA

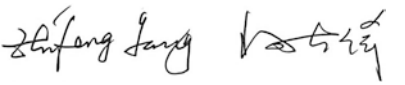
# Preface

For more than two decades, from the Brundtland Commission in 1987 to the Rio+ 20 Conference of the world leaders in 2012, debates on environmental sustainability and human welfare have challenged societies worldwide to seek innovative approaches to sustainable and equitable development. The multifaceted crisis of environmental unsustainability in China and India, intricately intertwined with threats to human security, has undoubtedly acquired unprecedented complexity as well as a sense of urgency in the era of extensive environmental degradation and climate change. Meeting the needs of a growing human population and a booming economy without compromising the long-term integrity of the environmental foundation for all life in China and India is the essence of the search of these two countries for sustainable development strategies at regional and global scales. This book aims to analyze the challenges and opportunities facing past and future innovations for environmental sustainability in China and India against their respective backdrops.

This book provides interdisciplinary perspectives through examining (a) the environmental impacts and future requirements of ecosystem services from the process of rapid economic growth that has characterized the recent economic history of China and India, and (b) the unfolding dynamics and dilemmas of the era of environmental challenges expressed as water scarcity, river and coastal pollution, degradation of forests and grasslands, and loss of biodiversity in the two most populous countries and fastest growing economies of the world. Various contributions to this book explore the progress and prospects of thinking differently and innovatively in China and India at diverse scales about ecologically sustainable, socially just, and culturally appropriate alternatives to growth-oriented models of social futures, ideas of modernization, and the role of knowledge in achieving it.

I am delighted to see the publication of this timely and productive book, *Environmental Sustainability from the Himalayas to the Oceans: Struggles and Innovations in China and India*. I thank the authors for publicizing their new research findings on environmental sustainability from Himalayan grasslands to the coastal areas, linked by Himalayan rivers, rural and urban landscapes in China and India. This book provides a compendium of information and insights that will prove

very useful in promoting environmental sustainability in these two large countries of Asia and other countries worldwide facing similar environmental challenges. I recommend this important publication to researchers, planners, policy makers, students, and public organizations concerned about environmental sustainability at local, regional, and global levels.



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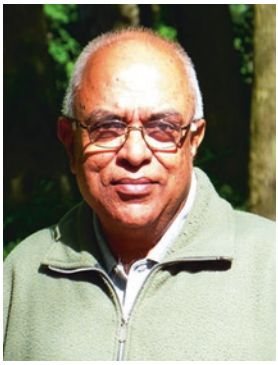

**Jayanta Bandyopadhyay** (born in 1947) obtained his doctorate in Engineering from the Indian Institute of Technology in Kanpur in 1975. Following that, he turned his professional attention to the interdisciplinary area of science and policy. This transformation was facilitated by his close interaction with the forest rights movement in the Indian Himalaya called *Chipko.* He has been a consistent researcher on various critical policy issues related to environment and economy in Asia, especially on the rivers originating from the Himalaya. In course of time he became deeply interested in understanding the relationship between human knowledge on the natural environment and its application by the humans.

He worked at ICIMOD (Kathmandu), International Academy of Environment (Geneva), and Indian Institute of Management (Calcutta). In 1991 he was invited by the Secretariat of the Rio Earth Summit to prepare a draft of the chapter on the world's mountains for inclusion in Agenda-21. He was President of the Indian Society for Ecological Economics (2006–2008) and a Fellow of the India-China Institute (New York). He is an adviser to the Water Diplomacy Program at Tufts University (USA). He has published more than 140 papers, books, articles, etc. His e-mail: jayanta@iimcal.ac.in

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He serves on the international editorial board of *Geopolitics* (Routledge) and *Co-operation and Conflict* (Sage). He is the founding Vice-Chairman of Indian Ocean Research Group (IORG) and coeditor of its flagship journal, *Journal of Indian Ocean Region* (Routledge). He is also the Regional Editor of *The Polar Journal* (Routledge) and a member of the international advisory board of *The Journal of Borderland Studies* (Routledge). Chaturvedi's most recent coauthored books are *Climate Terror: A Critical Geopolitics of Climate Change* (Palgrave Macmillan 2015) and *Climate Change and the Bay of Bengal: Emerging Geographies of Hope and Fear* (Institute of South East Asian Studies, Singapore). His e-mail: sanjay@pu.ac.in

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**Victoria Marshall** Victoria Marshall is a President's Fellow at the National University of Singapore, where she is pursuing a Ph.D. in Geography. She is also an Urban-Rural Systems researcher at the ETH Future Cities Laboratory in Singapore. She is currently teaching at Yale-NUS and has previously taught at The New School, Cornell University, Columbia University, Pratt Institute, University of Toronto, University of Pennsylvania, Harvard University, and the University of New South Wales. She was Associate Director of the Tishman Environment and Design Center in New York (2015–2016). She was awarded an India China Institute Fellowship that was focused on the topic of social innovation for sustainable environments (2010–2012). She has been a participant in the Urban Design Working Group at the Baltimore Ecosystem Study since 2006. Victoria Marshall is the founder of Till Design (tilldesign.com), a design practice for critical research that is socially and environmentally engaged (2001–ongoing). Within Till Design much work has been done to expand urban design practice, and to define ecological urban design theory and practice. Marshall is a licensed landscape architect in and a member of the American Institute of Landscape Architects. Marshall received a Masters of Landscape Architecture and Certificate in Urban Design from the University of Pennsylvania, and a Bachelor of Landscape Architecture from the University of New South Wales, Australia. Her e-mail: vm@tilldesign.com

# Acknowledgements

This book has been made possible through the generous support and help of many friends, colleagues, and organizations. First, we would like to thank India China Institute (ICI), the New School in New York, for hosting the contributing authors of this book in the ICI Fellows program. This provided the opportunity to the Fellows to travel and conduct researches, teaching, and conversations leading to the idea of this book. We are sincerely thankful to Prof. Ashok Gurung, Senior Director, and Prof. Mark Frazier, Research Director of the ICI, for their dynamic and imaginative leadership. Ms. Grace Hou, Office Manager, Dr. Nimmi Kurian, India Representative, Ms. Jianying Zha, China Representative of the ICI, and many more colleagues from India, China, and USA who have supported the third cohort ICI fellow program in many ways. We record our deep appreciation to Prof. Zhifeng Yang, Academician, Chinese Academy of Engineering, for writing the insightful preface to this book. Prof. Bojie Fu, Academician, Chinese Academy of Science, Mr. Nitin Desai, Former Under-Secretary General of the United Nations, and Prof. James Lassoie, International Professor of Conservation at Cornell University, gave thoughtful commentaries on this book for which we are very thankful. We acknowledge the substantial efforts and time of Saini Sherestha, Zachary Romano, Sarumathi Hemachandirane, Susan Westendorf and Silembarasanh Panneerselvam, the editors from Springer for publishing this book. We thank all our collaborators, including farmers/herders, professionals, practitioners, and social activists, who have kindly provided assistance in our research and field trips, classroom teaching, and the writing of this book. We like to thank organizations such as Ministry of Science and Technology of the People's Republic of China (Grant no. 2016YFC0501906), National Natural Science Foundation of China, Asian Scholar Foundation, Centre for Policy Research, New Delhi, and Parsons School of Design for supporting the Fellows at various stages of their work. The Indian Institute of Management at Calcutta, Beijing Normal University at Beijing, Punjab University, Chandigarh, and The New School at New York made it possible for the authors to join and spend time at the ICI Fellows Program. Most importantly, we are grateful to our family members for their support and understanding when we were involved in the ICI fellow program and subsequent writing of the book.

# Contents

# Chapter 1
# Introduction

**Sanjay Chaturvedi, Jayanta Bandyopadhyay, and Shikui Dong**

**Abstract** China and India, the "civilization twins" of the Himalayan sphere, are seeking continuous and extremely high rates of economic growth. For these two countries, and also for their neighboring countries, seeking multiscalar innovative responses to threats emanating from increasing environmental unsustainability is a matter of necessity and not choice. The critical challenge facing the two large countries is whether nearly three billion people inhabiting diverse sociocultural, economic, and ecological spaces, spanning from the Himalayas to the Oceans, could achieve the consumption patterns and economic standards of the Global North? The concepts of space, scale, and power—central to any formulation of environmental sustainability—have to be addressed and problematized. The contributions to this volume underline that China and India—as civilizations, polities, institutions, societies, and economies—will have to think and act differently at this critical juncture of their journeys.

**Keywords** Ecological civilization • Ecosystem services • Environmental flows • Environmental sustainability • Innovation • Natural environment • Planetary powers • Social innovations

## 1.1 Introduction

Starting from the Brundtland Commission to the World Conference of Rio+20, environmental sustainability has become a global goal. The question how much humanity has recognized the serious implications of generating innovations for

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S. Dong et al. (eds.), *Environmental Sustainability from the Himalayas to the Oceans*, DOI 10.1007/978-3-319-44037-8_1

achieving that goal, and by whom, has not received the attention due. The answer to the question becomes even more complex in the context of countries like China and India, with very large populations and their economic aspirations for a better quality life.

In order to place this book in proper perspective of the conceptual challenges, a brief discussion on the various ideas that have shaped the global debate over environmental sustainability would be useful. The traditional, that is the neoclassical economists, take environmental problems as an externality, that can be addressed through the growth process itself. They take help of the Environmental Kuznets Curve to show that with enough economic growth, economies can cross the peak of the Kuznets Curve and enter into the domain of unlimited growth with environmental sustainability. This position is often called "growth fundamentalism." Emerging economic thinkers, especially the ecological economists, finding roots in classical economics, take the view that the functioning and productivity of the biosphere impose an inherent limit to the use of nature as source of supplies and sink for wastes of human economic activities. Hence, unlimited growth beyond the hump of the Kuznets Curve is unrealistic. The traditional link of human development with growth in GDP is not tenable. In cases where the biospheric limits have been crossed while pursuing economic growth, humans have eaten into the natural capital, inflicting unsustainability. Such instances need to be rectified by compromising economic growth and altering related consumption patterns. Thus came the idea of degrowth or Steady State Economy for environmental sustainability. Daly et al. (1993) had recommended an early transition to global environmental sustainability. Following similar arguments, Hueting (2010) stressed the unsustainability of economic growth, if environmental sustainability has to be attained. Growth is seen in the "beyond growth" perspective as a purely quantitative process, while human development is seen to be largely a process of qualitative transformation, including environmental change.

In this background, we need to place the future scenarios for the two most populated countries with large developmental aspirations. What does the "Ecological Civilization" of China, identified as a target in the 12th Five Year Plan document, mean in this context? Will the political leaders of India be able to moderate the growth strategies in favor of environmental sustainability as related to the biospheric limits of nature as a source and a sink? These are monumental challenges to the science and policy community of both the Asian giants, which this book addresses in a small way.

This book aims at analyzing the challenge and opportunities facing innovations—made in the past and needed in the future—for environmental sustainability in these two countries against their respective backdrops. The book argues and illustrates that both China and India have been a part of the "Himalayan Sphere," which implies the borderless connectivity of a "spiritual and civilizational arena" (Chung 2015a) shared by the two "civilization-twins" over millennia. Both have long-standing philosophical traditions, like Confucianism, Taoism, Vedic, Buddhism, Jainism, and numerous animistic local traditions that have innovatively looked at the issue of environmental sustainability. In more recent past in both countries, the social and political thinkers like Gandhi, Tagore, Fei Xiaotong, and Ji Xianlin have

stressed the importance of combining ancient wisdoms, indigenous knowledge systems, and modern science in defining human futures and modernity.

This book provides interdisciplinary perspectives—especially from below—to the ongoing quest and conversations aimed at innovations for environmental sustainability, termed by some as ecosustainability in the two most populous and fastest growing economies of the world. As pointed out by Díaz-García et al. (2015), "Eco-innovation is still a young area of research: however it has been an area of increasing concern for policy makers, academics and practitioners." One major thematic trend on the research agenda relates to the "drivers of eco-innovation." Be it the debate on energy-resource geopolitics or sustainable development or environmental security or climate change, China and India continue to invite disproportionate attention, often bordering anxiety and fear (Economy and Levi 2014; Watts 2010).

Both China and India have passed through periods of intense search and debates on what their future should be like. Within the past several decades, critical policy innovations describing pathways to modernity have been expressed and practiced. In China, the Maoist concept of modernization was based on the central role of local knowledge systems while in the era of liberalization, led by the ideas of Deng, all sources of knowledge, especially those rooted in the European tradition, were taken as the vehicle for modernization. In India, Gandhi had the idea of the future of the country after independence to be based on strengthening the village economies and labor-intensive small-scale industrialization, with low level of environmental impacts. In contrast, the ideas that modernized post-independence India were based on a commitment to large-scale industrialization, of which the social and environmental impacts were significant. The question today is whether the billions inhabiting diverse sociocultural, economic, and ecological spaces in these two countries, from the Himalayas to the Oceans, can "develop" in a manner similar to millions in the Global North; riding on "carboniferous market capitalism" and its insatiable appetite for resources on land and at sea? Various contributions to this book explore the progress and prospects of thinking differently and innovatively in China and India at diverse scales about ecologically sustainable, socially just, and culturally appropriate alternatives to growth-oriented models of social futures and modernization. What kind of innovation is needed, if this goal has to be reached, in what kind of spaces (social, economic, institutional, legal) and at which scale?

Those inclined toward a more progressive view/sense of place (see Massey 1994) are more likely to describe China and India as ancient "Civilization States" (Chung 1998; 2015b; Xia 2014). Doreen Massey's progressive sense of place includes connections: "openness and change rather than boundedness and permanence" (cited in Cresswell 2004: 40). The two "Civilization States," having metamorphosed over just a few centuries into territorial "Nation-States," are now passing through a period of unprecedented economic growth with wide ranging implications for their societies, cultures, and environments. Tan Chung, inspired by Rabindranath Tagore, would further describe China and India as the two "Himalayan Sphere civilization-twins." To quote Chung: "There flows from Himalaya Ganga River into the Bay of Bengal and Indus River into the Arabian Sea. The two rivers join the Indian Ocean to draw

the contours of a "sphere of Indian civilization." Similarly, the third longest river on earth, the Yangtse, and the fifth longest, the Yellow, flow from the Qinghai-Tibetan Plateau of the Himalayas with one towards the east and the other towards the north. The two great rivers carved out the contours of the "sphere of Chinese civilization"" (Bandyopadhyay, Chap. 4 in this book).

This book is based on the assumption that multiscalar innovative responses to threats emanating from unsustainable environments—ones that inspire as well as deliver outcomes in the form of values/norms, products, policies, institutions, and practices—are a matter of *necessity* and not *choice* in these two countries. In this chapter, we introduce the contributions to this book with a brief theoretical–conceptual engagement with the diverse understandings of "innovation" and "environmental sustainability." We also point out how in various chapters the concepts of space, scale, and power—central to any formulation of environmental sustainability—have been addressed and problematized.

The authors in this book are quite conscious of the "limited" and "limiting" nature of various arguments that point out the futility of "comparisons" between China and India. The two neighbors are often approached and analyzed in terms of a long list of profound differences and sharp contrasts in terms of highly State-centric notions of political culture and structure, not without some justification. But once the analytical focus is liberated from the "territorial trap" (Agnew 1994) a different picture emerges. What we then see is the burgeoning consumer culture and consumption practices of the rich and the middle class, and assertions of marginalized communities and a section of the elite for social justice and environmental sustainability. In this regard, Bandyopadhyay in Chap. 3 and Chaturvedi in Chap. 8 take the example of the forest rights movement in the Indian Himalaya called *Chipko* (tree hugging).

## 1.2 Defining "Innovation": More Questions than Answers?

A cursory look at the burgeoning literature on the subject of "innovation" (Shavinina 2003), including articles published in a number of journals carrying *Innovation* in their titles, points toward considerable ambiguity surrounding a large number of questions. What does a particular innovation mean, to whom and why? How do these meanings vary between different disciplines? How and why do definitions of innovation vary over space and time? Is it feasible, or even desirable, to look for a universally accepted and applicable definition or understanding of innovation? How do we make out whether, and to what extent, one form of "green" innovation significantly differs from another? Who has the authority and legitimacy to judge who stands to *gain* or *loose* what, when, *where*, and how from one innovation or a set of it?

In the light of above, various contributions to this book approach and address multiple notions of innovation less in terms of rigid and "universal" definitions and more in terms of manifold meanings and practices. This critical analytical approach is being hinted at also through the use of the phrase "struggle" in the subtitle of the

book before "innovations." A struggle perspective reveals, besides grassroot movements, that at the heart of each and every notion and form of innovations—including those aiming at environmental sustainability—are struggles over knowledge claims, interpretations, interests, and worldviews. This applies as much to the notion of social innovation as to legal–institutional forms of innovation. And such struggles are present even in the *Jugaad* (frugal) innovation. We shall return to the issue of struggle later in the chapter.

## 1.3 Defining "Natural Environment": Beyond Wilderness

All the contributors to this book show some skepticism with regard to a view of "natural" environment akin to "wilderness" that excludes the human-social elements. This is not to deny or degrade the presence of "nature" in its own right but to strategically place the social and cultural as integral to the ecological. As pointed out by Sen (2004: 248–249), "focusing on the quality of life [political economy of life] can help in this understanding and throw light not only on the demands for sustainable development, but also on the content and relevance of what we can identify as 'environmental issues.'" This requires, as pointed out by Hulme (2008), bridging the gaps between the scientific understandings and cultural understandings of environmental sustainability. And this is precisely what Dong in Chap. 2 and Bandyopadhyay in Chap. 3 intend to achieve by demonstrating how the evolution of "natural environment" has been mediated from to ancient to the present by the civilizations and their cultures.

## 1.4 Defining' Innovations for Environmental Sustainability: Diverse Notions, Varying Emphases

More than two and a half decades ago, even before the Brundtland Commission was established in 1983 and the Earth Summit convened in 1992, Kothari (1980) cautioned against the enormous environmental costs of growth-oriented, technology-obsessed models of economic development and insisted on finding alternatives to highly seductive Western consumption pattern and lifestyle. He invited attention to "the global dimension of the present-day human predicament, marked by the inequity of simultaneous material abundance and overdevelopment in some regions or sections and underdevelopment, increasing poverty and deprivation in some others." He insisted on questioning "the dynamics of a global structure that forces a continual flow of resources away from non-industrialized into industrialized countries, and from a steady and sustainable to an accelerating and rapacious use of resources in the service of a parasitic and wasteful life-style that is now spreading to the developing countries as well." Kothari argued that consumption and consumerism of this kind "leads not only to the domination of man by machine

but also to an increasing redundancy of man himself, besides blighting the life chances of future generations." In his view "this science-and-technology posits development and environment in an adversary relationship, and thus puts developmentalists and environmentalists in two hostile camps" (Kothari 1980: 427). In our view, Kothari offered an innovative vision of sustainable environments by highlighting:

> The urgent need for rediscovering the other traditions that take an integrated and holistic view of life as a whole, in which science and technology and development and environment all merge in a symbiotic relationship. This entails the search for an alternative concept of both development and technology as well as of life-styles, so as to ensure diversity in consonance with local resource endowments (human, material and technical), foster self-reliance and autonomy, and promote equity and participation, not only in economic and political processes, but also in giving meaning and content to human dignity at various levels.

Another important innovative perspective that has questioned the wisdom of "growth fundamentalism" is that of "Steady State Economy" or "Zero Growth Economy." According to its key proponent Herman Daly (2008) growth economy has been around for nearly two centuries, which makes it difficult to visualize a steady-state economy (SSE). This is despite the fact that for centuries mankind has "lived in an economy in which annual growth was negligible." Some express serious doubts on the feasibility or even desirability of achieving SSE due to apprehension that it would amount to the loss of both freedom and quality of life. Others feel that once the desired innovations are achieved in the domain of technology, such as energy efficiency and recycling, it will be easier to realize the transition to SSE. According to Daly:

> Regardless of whether it will be hard or easy we have to attempt a SSE because we cannot continue growing, and in fact so-called "economic" growth already has become uneconomic. The growth economy is failing. In other words, the quantitative expansion of the economic subsystem increases environmental and social costs faster than production benefits, making us poorer not richer, at least in high-consumption countries. Given the laws of diminishing marginal utility and increasing marginal costs this should not have been unexpected. And even new technology sometimes makes it worse. For example, tetraethyl lead provided the benefit of reducing engine knock, but at the cost spreading a toxic heavy metal into the biosphere; chlorofluorocarbons gave us the benefit of a nontoxic propellant and refrigerant, but at the cost of creating a hole in the ozone layer and a resulting increase in ultraviolet radiation. It is hard to know for sure that growth now increases costs faster than benefits since we do not bother to separate costs from benefits in our national accounts. Instead we lump them together as "activity" in the calculation of GDP.

Despite such notes of caution, the dominant understandings and narratives in circulation seem to suggest that the major criteria for various innovations to qualify as "Environmental Innovations" or "Eco-Innovations" or "Green Innovations," or "Less-polluting Innovations" is that "they would result in better use of natural resources and reduce the ecological foot print" (Díaz-García et al. 2015: 7). The prevalent diverse notions of environmental sustainability could be broadly divided into three categories: (a) innovations that focus on effects, (b) innovations that focus on motivation, and (c) innovations that focus on both motivation and effects (Díaz-García et al. 2015: 9).

### 1.4.1 *Spaces of/for Innovation for Environmental Sustainability: Persisting Mismatch Between Ecological and Geopolitical*

As pointed out earlier, one "common ground" on which various chapters in the book hold together, despite their diverse disciplinary inclinations, is what we referred to at the beginning of this chapter as a progressive sense of place. This progressive sense of place becomes both compelling and visible in case of environmental flows for rivers (see Bandyopadhyay in Chap. 4 and Chaturvedi in Chap. 8). As reminded by William Cronon in his book *Nature's Metropolis* "places need to be understood as sites that are connected to others around the world in constantly evolving networks which are social, cultural, and natural/environmental. Places need to understood through paths [see Dong in Chaps. 5 and 6 and Marshal in Chap. 9] that lead in and lead out" (cited in Cresswell 2004: 43).

A state-centric approach, which undermines the dynamics of a progressive sense of place, has been criticized by Agnew (1994, 1998, 2003), who coined the term "territorial trap" in order to draw attention to the prevalent notion of state-space as a pregiven, static container within which people "chosen" by a set of boundaries are being socialized into territorialized notions of citizenship, democracy, and order. Agnew rightly points out the need to question this state-centered account of the spatiality of power and so does Srinivas in Chap. 7 by underlining the importance of civil society and networks in the politics of social innovation.

Despite most persuasive arguments and evidence to the contrary, the dominant discourses of environmental sustainability have remained sovereignty obsessed and highly territorialized. The mismatch between the spaces of environmental flows and the spaces of bounded places persists. As pointed out by Camilleri and Falk (1992: 172), "as ecological problems impinge with increasing sharpness on our consciousness, individuals, communities and states are confronted with challenges, concepts and perspectives which are at odds with the simplified image of the world upon which the theory of sovereignty was itself originally constructed." They are quite right in reminding us that, "none of the above should be taken to mean that in relation to ecological problems the sovereignty discourse is by now a dead letter. The discourse is in a state of tension and transition" (Camilleri and Falk 1992: 185).

### 1.4.2 *Scale and Scaling: Ethical and Geopolitical Dimensions*

Both China and India have also been termed as "Planetary Powers." The concept of "Planetary Powers" graphically reveals the unprecedented scale of the economic and ecological outreach/consequences of growth-oriented economic pathways that are being followed by China and India as modern nation-states. The term "Planetary Powers" was first used by a Worldwatch Institute Report (Worldwatch 2006) nearly a decade ago. The Report pointed out that, "These two countries are now also planetary powers that are now shaping the global biosphere and are therefore central

to whether the world succeeds in building a healthy, prosperous, environmentally successful future for the next generation. As China and India become world-class economies, they are set to join already industrialized nations as major consumers of resources and polluters of local and global ecosystems. While the largest burden of these developments will fall on China and India themselves, their global impact is clear" (Ibid.).

The role and responsibility of the two "Planetary Powers" are going to be severely tested by the efficacy of their resolve to mitigate the emission of greenhouse gases, and thereby address the challenge of climate change. As a general strategy the two neighbors will have to integrate their commitment to climate change mitigation both into their overall economic strategy and the goal of environmental sustainability. The developmental choices of both, including choices related to energy use, are going to be affected by the commitments made by them under their respective Intended Nationally Determined Contributions (INDCs) at the UNFCC 21st Conference of the Parties (CoP 21) held in 2015 in Paris. With climate change now inscribed in bold on the agenda of environmental sustainability, both will be under considerable international and domestic pressure to review and renew their resolve to redefine the very meaning and essence of the notion of "economic development." This no doubt will further add a sense of urgency to innovate appropriate solutions to the challenge of sustainability both in terrestrial and marine environments as underlined by Chaturvedi in Chap. 8.

As shown by various chapters in this book, the interplay between the *process* of innovation for environmental sustainability and the *scale* at which it is conceived carried out and operationalized is quite complex. The question as to which particular scale to choose, privilege or marginalize, in search of innovation of a particular kind, in a particular space, is driven by a complex mix of ethical, economic, and political considerations (Bunnell 2001). And the choices that are being made or skipped with regard to space and scale are influenced to a large, though varied, extent by ever shifting knowledge-power equations. It is equations such as these that seem to overwhelmingly decide the visibility and significance of certain innovations, in certain spaces and at certain scales at the cost of others. The outcome is the relative invisibility and marginalization of certain sites and sights of struggles in China and India that are highly innovative in terms of their nature, scope, hopes, and assertions. One of the key hopes and ambitions shared by various interdisciplinary contributions to this book relates to making these ongoing struggles in China and India more visible and a part of the "mainstream."

## 1.5 Introducing the Chapters in the Volume: Contexts, Texts, and Practices of Environmental Sustainability

One central and common theme that holds this volume together is the search for what Acharya (2014) would term as the imperative of "Global" International Relations (IR); incorporating non-Western experiences, wisdoms, and struggles in

the so-called mainstream IR (Acharya and Buzan 2010; Hobson 2012; Ling 2001, 2013, 2014). As noted earlier, social innovations for environmental sustainability have been integral to "civilizational journeys" in various parts of the globe. It is useful to remember that transborder flows of goods, ideas, and humans across the Himalayas are much older than state territoriality and national borders. The distortions and biases that slowly crept in due to the import of Eurocentric Westphalian understanding of modernity, sovereignty, and security are of a more recent origin. Hobson (2012) has shown how the Western IR theory has been biased in favor of a Eurocentric conception of "world politics." His rigorous analysis of the major conceptual, theoretical, and empirical domains of IR over a long period of time (1760–2010) shows how issues of "natural environment," climate were deployed in racist narratives of western civilizational mission from time to time.

In both China and India geographically diverse indigenous knowledge systems, philosophical traditions, and cultural worldviews were harnessed to address various environmental challenges and opportunities. A wealth of innovative ideas have been tested over centuries in China and India with regard to how a proper balance can be maintained between the natural and the social. There have been several ups and down in the environmental movements in both the countries and a number of useful lessons can be learnt from the past. Equally important and insightful is the reminder by Guha (2000: 3) that, "environmentalism [to be distinguished from 'environment'] must be viewed as a *social* program, a charter of action which seeks to protect cherished habitats, protest against their degradation, and prescribe less destructible technologies and lifestyles." Also, "like all social movements, the environmental movement has within its fold individuals, trends, traditions and ideologies" (Guha 2000: 5). There are, as pointed out by Guha, varieties of environmentalism and this historical account needs to be kept in mind in deciding the spaces and scales of innovation for environmental sustainability.

Contributions by Dong in Chap. 2 and Bandyopadhyay in Chap. 3, using a historical perspective, illuminate the ecological ups and downs on the "Civilizational Road" taken by both China and India over long centuries. They show the contrast between the social–natural resilience inherent in the ecological wisdom of ancient times and the dependence on various innovations for sustainable environments in the modern techno-scientific era. Both argue and illustrate in favor of integrating ancient wisdom and indigenous knowledge with innovations in modern science while seeking answers to contemporary environmental problems. Both further demonstrate that in the twin civilizations of the Himalayan sphere we find a wealth of indigenous philosophical wisdom on human–nature interactions, on the one hand, and governmental and nongovernmental interventions in favor of environmental sustainability, on the other. This is not to suggest that there is nothing in historical or premodern China and India that was not harmful to environment. The fact remains however that national, subnational, and local histories of both environmental sustainability and unsustainability carry lessons that must be factored into the pursuit of desirable and *sustainable futures* in these two civilizational polities. The notion of "Ecological Civilization" becomes important here and symbolizes the collective values and wisdom of various cultures and traditions in favor of harmony

between nature and the humans. Dong also shows how the Chinese government has promoted grassroot participation by communities by launching the concept of "Ecological Civilization" and "recycling resources through religious beliefs, inherited traditions, and cultural practices." Besides major economic innovations, China has also made significant advances in terms of innovative technologies to address wide-ranging challenges including resource and energy saving.

Dong further talks about the people-centric environmental ethics enshrined in the philosophy of the great sage Confucius. According to Tucker (2015: 35), in the worldview of Confucius, "the mutual attraction of things for one other in both the human and natural worlds gives rise to an ethical system of reciprocal relationships. The human is deeply embedded in a network of life-giving and life-sustaining relationships and rituals. Within this organic universe the human is viewed as a microcosm of the macrocosm where one's actions affect the larger whole, like ripples in a pond as expressed in the Great Learning (Daxue)." Dong also underlines the emphasis placed by Taoism on responsibility of humankind to "learn to become stewards of the biosphere," on the one hand, and act "by non-acting—that is, by acting in harmony with the natural flow" (Xia Chen 2015: 44).

Bandyopadhyay in Chap. 3 maps out environmental changes in India (in a civilizational sense today's South Asia) from ancient time to the postcolonial era. He shows how over a period of about five millennia the relationship between humans and their immediate natural milieu has been dynamic; ranging from being symbiotic to predatory. Bandyopadhyay goes on to describe the social innovation by rural people, especially women, in the villages of Uttarakhand State of Indian Himalayan Region, known as the *Chipko* movement. This movement was an expression of conflicts over access to forest resources between the village communities and external contractors appointed by the governmental forest department. In the same chapter, he introduces the remarkable judicial innovation in India in the form of Public Interest Litigation that has been effective in promoting sustainability, moving to the establishment of the National Green Tribunal.

### *1.5.1 Environmental Flows, Ecosystem Services, and Ecological Restoration*

Yet another key concept that assumes critical importance in the context of innovation for environmental sustainability for both China and India is that of flows: environmental and human. Equally useful is the concept of "*ecosystem services.*" The Millennium Ecosystem Assessment (MA), conducted by leading scientists from more than 100 nations over a period of 4 years and released in 2005, has provided rich insights with factual details about "how human beings have altered ecosystems, and how changes in ecosystem services have affected human well-being, how ecosystem changes may affect people in future decades, and what types of responses can be adopted at local, national and global scales to improve ecosystem management and thereby contribute to human well-being and poverty alleviation" (Millennium Ecosystem Assessment 2005).

The MA defines an ecosystem as "a dynamic complex of plant, animal, and microorganism communities and nonliving environment interacting as a functional unit" and deals with "the full range of ecosystems—from those relatively undisturbed, such as natural forests, to landscapes with mixed patterns of human use, to ecosystems intensively managed and modified by humans, such as agriculture land and urban areas" (Millennium Ecosystem Assessment 2005: v). Here is yet another important acknowledgment that geography continues to matter in any pursuit of sustainability. According to MA, "ecosystem services are the benefits people obtain from ecosystems. These include *provisioning services* such as food, water, timber, and fiber; *regulating services* that affect climate, floods, disease, wastes and water quality; *cultural services* that provide recreational, aesthetic, and spiritual benefits; and supporting services such as soil formation, photosynthesis, and nutrient cycling." This raises in our view the proverbial billion dollar question with regard to benefits "people obtain from ecosystems": who gets, what, when, where, and how? Who or which agency decides the "authoritative" allocation of ecosystem services?

The MA "Framework for Understanding Ecosystem Services and Ecosystem Change" talks of three scales (global, regional, and local) and divides the "drivers of change" into two broad categories, namely, "indirect" and "direct." Whereas the indirect category comprises factors such as demographic, economic (e.g., globalization, trade market, and policy frame), sociopolitical, science and technology, cultural and religious, the direct category is said to consist of factors such as changes in local land use and cover, species introduction or removal, technology adaptation and use, climate change, harvest consumption, and so on. This fuzzy distinction as well as complex interplay between the two categories demands some scrutiny, especially in the context of neoliberalism. We wonder as to what extent are the market, corporate globalization, and neoliberal capitalism "indirect" drivers in terms of their impacts on and implications for *access to*, *control over*, and *distribution of* various ecosystem services.

Evidence to the contrary is provided by Bandyopadhyay in Chap. 4, Srinivas in Chap. 7, and Chaturvedi in Chap. 8. Critical social science perspectives, embedded in facts furnished by natural sciences, are applied in Chap. 4 by Bandyopadhyay and in Chaps. 5 and 6 by Dong to study flows (Fig. 1.1). Bandyopadhyay analyses a series of human innovations in China and India related to the use of the rivers emerging from the Himalayas. Special focus has been given on the Yellow River in China and the Ganges in India. Both these rivers are revered as Mother Rivers in the respective countries. Both countries have made mistakes in not taking care of the Mother Rivers and are now trying to restore the ecological status of these two rivers. Recognition of environmental flows both as a natural and social requirement of rivers is an important innovation in both countries to promote environmental sustainability.

Dong in Chap. 5 highlights the importance of Himalayan grasslands in terms of ecosystem services provided for both upstream and downstream people and the environmental problems associated with grassland degradation in Himalayan region. More than 50 % of land territory in the Himalayas is covered by grasslands, which supports about 150 million people for their livelihood in the upstream regions, and three times as many people living in downstream regions with important eco-

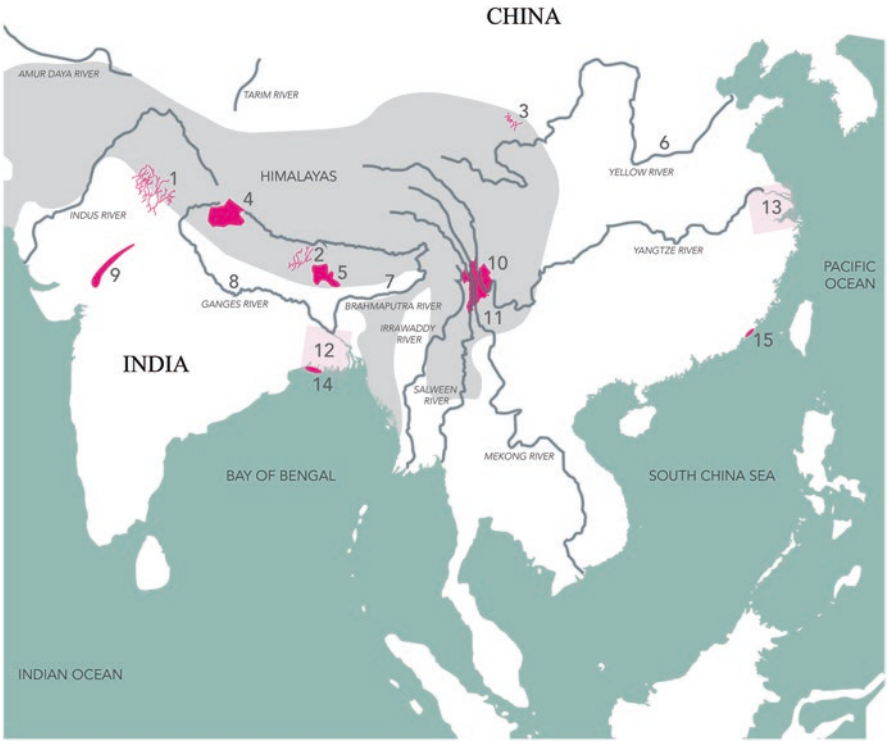


**Fig. 1.1** Himalayas-to-Oceans and case study sites (drawing by Victoria Marshall) which are shown in different numbers as *1, 2,* and *3* representing the transhumance grazing management on the mountain grasslands in Himachal Pradesh of India, Rasuwa District of Nepal, and Tianzhu County of China; *4* and *5* representing the trans-boundary biodiversity conservation in Kailash and Kanchenjunga; *6, 7,* and *8* showing the sustainable water resource management of Yellow River, the Brahmaputra, and the Ganges River; *9, 10,* and *11* representing the environmental grassroot and civil society in Aravalli Ranges of India, Gaoligong Mountain, and Lashi Lake of China; *12* and *13* representing urban ecology design in Ganges-Brahmaputra-Meghna Mega Delta and the Yangtze-Qiantang Mega Delta; *14* and *15* struggles of the coastal communities for fast-degrading mangrove forests in the Sundarbans of India and Zhangjiangkou of China

system services. However, environmental degradation associated with human over-exploitation and climate change has been challenging the sustainability of the Himalayan grasslands. Building on the case studies from grassland ecosystems and pastoral societies across the Himalayan countries, China, India, and Nepal, Dong argues and illustrates that the indigenous knowledge and local institutions are critically important to promote the sustainable grassland management in the Himalayan region. The local pastoralists in the Himalayan region have developed adaptive strategies through social innovations to mitigate environmental challenges and socioeconomic pressures. Adjustment of grazing practice and grassland management is an important adaptation strategy derived from evolving traditions of pastoral communities.

Dong in Chap. 6 maps out the biodiversity of eastern Himalayan region, particularly the terrestrial ones. He highlights the importance of transboundary biodiversity conservation across India, China, Nepal, and Bhutan. He argues that inadequacy of the institutional arrangements and shortcomings of governance practice are challenging the effective conservation of transboundary biodiversity in this region. He proposes that regional institutions, in close collaboration with national governments, are needed to develop a vision for an integrated approach to institutionalize the transboundary biodiversity conservation.

### *1.5.2 Social Innovations for Environmental Sustainability: "Markets, Bazaars and Beyond"*

Social innovations are—and ought to be—"innovations that are social in both their ends and means" (European Commission 2010) be they in the form of ideas, movements, or outcomes. Social innovations are expected to meet social needs, create new social relationships, and collaborations both within and across diverse boundaries. What are the spaces, sites, and scales where one should be looking for social innovation for sustainable environments in a globalizing world? One of the key assumptions of this book is that in the era of climate change and "scarcities," social struggles demanding livelihood security, environmental sustainability, and climate justice at the grassroots level in the Global South do qualify as pursuits of bottom-up social innovation. In other words, the micro politics of resistance demands the attention of those interested in the theory and practices of social innovation.

One of the key and critical engagements with the concept of social innovation in this book comes from Srinivas in Chap. 7. He investigates how the concept of social innovation (SI) could be deployed to address two sets of ecological questions. First, in what ways can innovative local management actions at the grassroots reinforce and rejuvenate ecosystem responses to various crises? Second, what kind of socially innovative organizational responses are available (or could be made available) to coordinate ecosystem responses? Emphasizing that the process and the outcome of a social innovation aimed at environmental sustainability must result in the strengthening of both environmental and social, Srinivas's chapter draws attention to the challenges posed by unfolding neoliberal forces to community-centric and network-based approaches.

The extent to which market-driven approaches to innovation for environmental sustainability will work in China and India remains an open question inviting debate. Bakshi's analysis of how the dialogic culture of *Bazaar* has been undermined by market-driven, profit-seeking monologue has a number of valuable insights to offer (Bakshi 2009). She reminds us that, "bazaars and marketplaces have fundamentally been a point of connection and conversation. More importantly, until about two hundred years ago, these conversations were as much about civilization-making values and politics, as about material exchange" (Bakshi 2009: 3). We find numerous examples of Bazaars in China and India. To quote Bakshi:

> The bazaar, an ancient mechanism of human society, is quite distinct from what we now call the "free market." Bazaar refers to a location, the market is an idea. Bazaars brings together buyers and sellers, eyeball to eyeball, for open and direct exchange. The free market mechanism emerged in the eighteenth-century Europe fostered complex mechanisms of more indirect and distant exchange. Within the babble and bustle of bazaars buying and selling were tossed together with storytelling, politics and even the framing of moral values. By contrast, the idea of a free market depends on assiduously separating the economic sphere from the rest of life (Bakshi 2009).

Will the contradictions and crisis of capitalism and the market culture, especially the environmental crisis, open up spaces for the reemergence of the social and the conversations? Can the Chinese and the Indians—as civilizations, polities, institutions, societies, and economies—think and act differently at this critical juncture of their journeys? In order to be able to do so, the two Asian neighbors will have to bear in mind that, "Such dark choices are not new. They have repeatedly surfaced in the journey of civilization" (Bakshi 2009: 390).

In both India and China, there are ancient texts full of ecological consciousness and wisdom. Many of the contemporary concerns with regard to limited nature of resources on earth and imbalance between humans and nature found strong expressions in both textual and visual forms. In case of China, Buddhist, Daoist, and Confucian traditions are being remembered and recalled for their innovative and respectful approach toward the natural environment. As pointed out by Palmer (2013), "desire to find ways of being and living which reflect deep Chinese cultural traditions, wisdom and insights is now a considerable movement not just amongst young Chinese but across all age groups. Daoism and Confucianism, as the two indigenous spiritual and philosophical traditions of China, are at the very core of the recovery of a specifically Chinese perspective on protecting our planet." Similar growth of interest in the ecological contents of ancient philosophical texts such as the *Vedas* can be seen in India.

Desai (2009) has shown how the Vedic texts are deeply ecocentric. "The ideas of the *Prakriti [Nature]* incorporate countless meanings. The celebrated *Prthivi-sukta* (also referred to as *Bhumi-sukta*) in the *Atharva Veda* sums up the Vedic attitude towards earth… The entire earth is continual by a harmonious cosmic principle; this principle is known as *Rta* or cosmic order in Vedic system. It is the self-regulative law of harmony. It is the uncongenial power, the underlying regulator of all life on earth at the natural and human level. The two functions of the earth, birth and death, are embodied in the fundamental ecological principle of interdependence. In every environment, the hilly, desert or forest, the plant and animal species that constitute the biotic community, together with the soil, air, and water are inherently organized so as to form a unified life support system. There exist elaborate and extensive networks. If even one fraction of this association is harmed, it would destroy and weaken the whole composition." In modern scientific literature such principles are called ecosystemic linkages.

Coastal communities, whose livelihood security critically depends on the sustainability of marine environments, are faced with an uncertain future in both China and India. Marine and costal environments and their resource base worldwide, especially Global South, are in serious decline (Global Ocean Commission 2014).

Chaturvedi in Chap. 8 maps out the ongoing struggles by the coastal communities of fast degrading mangrove forests of the Sundarbans and Zhangjiangkou—spaces of exceptional ecological importance linking the terrestrial and the marine environments. He shows how the challenge of innovation for sustainability acquires its own dynamics and dilemmas, especially in the case of *in-between* marine environments of the Sundarbans shared by India and Bangladesh. He argues that social struggles aimed at environmental sustainability and driven by the insight that "good ecology is good economics," such as the *Chipko* (also discussed by Bandyopadhyay in Chap. 3) are both relevant and needed not only in terrestrial-forest environments but also marine-coastal environment in both the countries. Struggles of this kind are needed to imagine and create new spaces—social, economic, political, institutional, and intellectual—for bottom-up innovations aiming environmental sustainability.

Marshall in Chap. 9 argues in favor of broadening and deepening both academic and policy imaginations of social innovation through "an analysis of existing city models and translation of emerging urban ecology theory." She wonders what would happen in case the ecosystem boundaries of various spaces and sites are seen interacting and intersecting. May be this will lead to new imagined geographies of social–cultural affinities. In her view, it is important to acknowledge that there is a complex geography to city–village mix that is intensifying and aging in a rather complex manner in both China and India. She further argues and persuasively illustrates that it is well within our ability to imagine, map, and even design hope inducing—in place of fear generating—delta interactions between the "Himalayan Sphere civilization-twins."

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# Chapter 2
# Environmental Struggles and Innovations in China: A Historical Perspective

**Shikui Dong**

**Abstract** This chapter presents and updates the information about the situational contexts, threats, problems, challenges, and solutions for environmental sustainability in China. This has been taken in temporal scale with a historical lens to show the environmental wisdoms, struggles, and innovations from ancient times to modern era. Chinese civilization with long history has rooted the ecological wisdoms and developed institutional arrangements for sustainable development. The "harmony between the heaven and human" in ancient China was an important philosophy and outlook on human–nature relationships for sustainable development. Yuheng functioned as the internal institution to develop and implement the relevant policies for protecting and utilizing the natural resources in a sustainable manner in ancient China. However, deforestation associated with war, fire, construction, reclamation, etc. in ancient times led to destruction of massive natural resources and serious degradation and territory land. Environmental pollution and land degradation associated with human population growth, economic development, land-use changes, and climate change are challenging the sustainable future of China. The historical lessons and the existing challenges have urged China to seek innovative ways to solve the environmental problems. China has made great efforts to take integrated measures and multiple actions to cope with the complex issues of environmental risks. These efforts include institutional innovations of empowering environmental protection agency, political innovations of reforming natural resource and environmental management strategies, economic innovations of adjusting development patterns, social innovations of promoting public participation, as well as technological innovations of developing new approaches for pollution control and ecological restoration.

**Keywords** Environmental history in China • Environment governance • Environment protection • Natural resources • Economic innovations • Political innovations • Social innovations

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S. Dong et al. (eds.), *Environmental Sustainability from the Himalayas to the Oceans*, DOI 10.1007/978-3-319-44037-8_2

## 2.1 Practice and Challenges of Environmental Management in Ancient China

Chinese civilization has been maintaining sustained development over the past thousands of years. Traditional Chinese culture contains rich thoughts and ideas on environmental protection and utilization of natural resources. For environment and resources management, ancient Chinese have developed ecological wisdoms based on harmonious relationships between human and nature, which was consistent with the modern concept of sustainable development. These thoughts and ideas were fixed by ruling class through legal system and establishment of government institution to guide people's practice, constrain people's behavior, and standardize social production activities. This effectively prevented excessive materialization of man and curbs unbridled plunder of nature and ensured sustainability of civilization development in ancient China, although there existed some insignificant environment problems due to natural disasters or inappropriate human activities in Chinese history.

### *2.1.1 Use of Ecological Wisdom in Environmental Management*

The "harmony between the heaven and human" in ancient China is an important philosophy and outlook on nature. Different from "God" of western countries, "heaven" here refers to nature and objective law of nature. The relationship between man and nature is called the "relationship between heaven and man." The ecological idea of "harmony between the heaven and human" is rooted deeply in the minds of the most representative Taoist school and Confucian school in ancient China.

Taoist school is an ancient school of philosophy in China with Lao Tzu (571–471 BC) and Zhuangzi (369–286 BC) as the representatives. The book *Yi Jing* described the Taoist philosophy, which systematically expounded the relationship between heaven and man (Fig. 2.1). Man and universe are an inseparable unity, "the Tao of heaven" and "Tao of human" are in harmony and unity. "Tao" is both the law that universe complies with and the rule that human conduct should observe. It recognizes that man is part of nature, imposing deep influence on the development of ancient environmental ethics of China. Lao Tzu said: "Tao begets the One. The One consists of Two in opposition (the Yin and Yang). The Two begets the Three. The Three begets all things of the world." He stresses that "Tao" is the origin of man and everything in the world and universal law of the universe and reflects harmony and unity between man and nature.

The Confucian school is the mainstream of traditional Chinese culture. Fundamentally, the attitude of Confucian school to nature was consistent with that of Taoist school. Confucians (551–479 BC) believed that man was part of nature. Man should take obedient and friendly attitude toward nature and take seeking the harmony between man and nature as the ultimate goal. However, there were some


**Fig. 2.1** Imitated bamboo slip book of *Yi Jing* (photo by Shikui Dong)

differences between Confucian school and Taoist school. The main concern of Confucian school is people. Although recognizing that the way of man is based on the way of heaven, Confucian school believed that as the wisest of all creatures, man could do his best and correlate with nature. On this basis, Confucian school forwarded the rich thoughts on appropriate development, utilization, and protection of natural environment. These thoughts contain traditional Chinese environmental ethics. Confucian school believed that "the benevolent takes the universe as a whole"; respecting nature is respecting human himself and cherishing the life of others is cherishing his own life. Confucius, the representative of Confucian school believed that heaven has moral tendency and inseparable relation with human beings. The meaning of the "heaven" in "harmony between the heaven and human" refers to natural law. The core of the "harmony" between man and nature refers to complying with nature. Xun Zi (313–238 BC), another representative of Confucian school pointed out in his article *Xun Zi-Tian Lun* (Fig. 2.2): "Although heaven has changes, earth has rich resources, man has his methods to govern nature and society and create opportunities according to law of nature." Xun Zi believed that only let nature take its course can human beings take opportunity and utilize everything. He stressed that man cannot influence and facilitate the forces of creation of the universe until he was able to get to the bottom of laws of human beings and physical nature. His thought "man's will, not heaven, decides" also is based on the understanding of the "harmony between the heaven and human" and that man should comply with nature and not go against timing.

Among various schools of thought of ancient philosophers in China, the thoughts on observing law of nature, protection of eco-environment, and sustainable utilization of resources as an important force run through the development process of

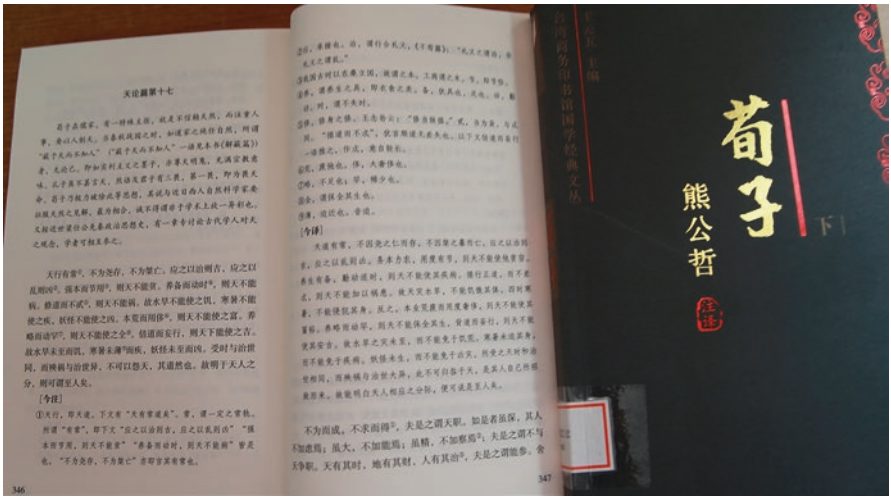


**Fig. 2.2** Modern copy of the book, *Tian Lun* (on Heaven), written by Xun Zi (photo by Shikui Dong)

Chinese civilization. As a result, the Chinese civilization still goes on after going through all kinds of hardships of the past several thousand years and benefits future generations. This principle of harmony between man and nature played an important role.

As early as Zhou Dynasty (1046–256 BC) of China, the book *Yi Zhou Shu-Ju Pian* (Fig. 2.3) stated: "People should not cut trees in early spring to facilitate growth of grass and trees. People should not employ fishnet in rivers and lakes in summer time to facilitate growth of fish and turtles." The book *Guo Yu-Lu Yu* attaches importance to the protection of animal and plant resources with relatively strong specific measures. Guan Zhong (719–645 BC) in East Zhou Dynasty (770–256 BC) understood the importance of protecting eco-environment; advocated state monopoly on mountains, forests, rivers, and lakes; and regarded the protection of mountains, forests, rivers, and lakes as a moral obligation for kings. In the book *Shi Ji* (*Yin Ben Ji*) (122 BC), it contained the bud of the concept of environmental protection. It notes the importance of not carrying out destructive hunting. In the book *Yi Wu Zhi* written by Yang Fu in Han Dynasty (206 BC–220 AD), the authors advocated wide protection of rare and precious wild plant and animal species in order to better protect natural resources and eco-environment. These ideas fully reflected the ecological civilization thoughts on complying with natural law and protecting eco-environment.

In addition, ancient Chinese philosophers understood the close relations between production and environmental protection. They presented the idea of maintaining the regeneration capacity of natural resources, advocated appropriate development of natural resources, and opposed the adoption of extinct approach. It was written in the book of *Lü Shi Chun Qiu* (Fig. 2.4) published in 239 BC "You could catch fish in current year if you drain the pond to get fish. But you cannot catch fish in the next

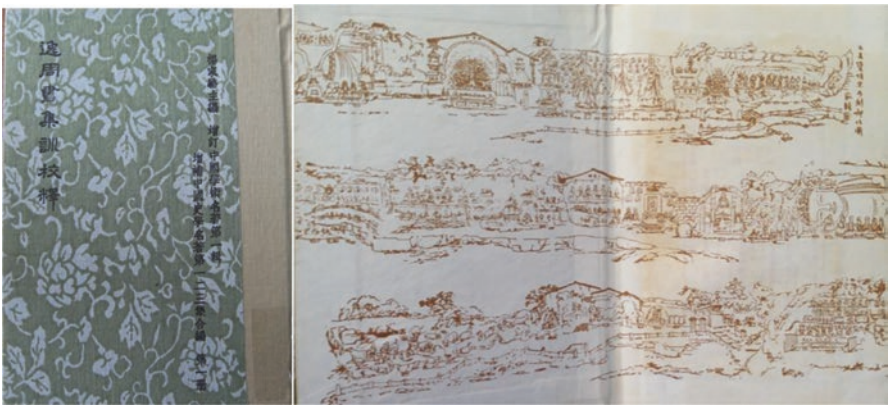

**Fig. 2.3** Modern copy of the book, *Yi Zhou Shu* (photo by Shikui Dong)


**Fig. 2.4** Modern copy of the book, *Lü Shi Chun Qiu* (photo by Shikui Dong)

year. You could catch wild animals in the current year if you burn forests, but you cannot find any wild animals here next year." In the book of *Huai Nan Zi* (Fig. 2.5), Liu An (180–123 BC) in Han Dynasty (206 BC–220 AD) stated "People should not kill pregnant animals, collect the eggs, catch fish in shallow water less than 1/3 meter, or eat baby swine." It stressed that human production activities should be based on maintaining regeneration capacity of environments and natural resources. These


**Fig. 2.5** Modern copy of the book, *Huai Nan Zi* (photo by Shikui Dong)

insightful thoughts stressed that human production activities should be based on maintaining regeneration capacity of resources and reflecting ecological civilization thoughts on protecting eco-environment, maintaining ecological balance, and sustaining use of natural resources.

### *2.1.2 Implementation of Legislation for Natural Resources and Environment Protection*

Each dynasty of ancient China promulgated a series of government policies on protecting natural resources and eco-environment. With legal system, the ruling class turned a series of thoughts and views on harmony between human and nature into law or act to constrain human behaviors and regulate production activities.

Act of *Fa Chong Ling*, known as the earliest environmental protection act in the world, promulgated in West Zhou Dynasty (1046–771 BC) stated: "People shall not destroy house, drain the well, cut down the trees or kill wildlife without permission. Any one in violation shall be sentenced to death without mercy." In addition, the policies of natural resources and environmental protection such as *Ye Jin* (Wildness Ban) and *Si Shi Zhi Jin* (Ban in four different seasons) were developed and imple-

**Fig. 2.6** Imitated bamboo slip of *Tian Lü* act (photo by Shikui Dong)

mented. In Qin Dynasty (221–206 BC), *Tian Lü* (Fig. 2.6), the most complete act of environmental protection law in ancient China was promulgated. This act (*Tian Lü*) expounded the strict protection of natural resources and the environment, including all kinds of biological resources. For example, it stressed that farmers cannot cut down trees on mountain slope for cultivation, fisherman cannot catch fish with poison, and hunters cannot catch and kill young birds and animals.

The theory and practices of natural resources and eco-environment protection policies were well in Han Dynasty (206 BC–220 AD) and Tang Dynasty (618 AD–907 AD) of ancient China. The ruling class stressed the importance of appropriate land management and environmental protection in social development. Especially in Tang Dynasty, mountain forests, wetlands, grazing pastures for livestock, hunting, urban greening, sewage discharge, suburb temples, altars, and the famous mountains were well managed by government administration. *Tang Lü* (The Law of Tang Dynasty) presented detailed measures for protecting natural environment and living environment and punishment for violator. According to the book of *Jiu Tang Shu* (Old Book of Tang History), which was completed between 940 and 945 AD, the Tang Dynasty's government identified the areas including Jingzhao (it is called Xi'an presently) and Henan with diameter of 300 km as the preserved areas, which were banned for logging or hunting. The government at that time initiated 'Nature Reserve' to protect natural resources and ecological environment, and the environmental protection regulations played big roles in protecting the beauti-

ful landscape. The economic and cultural prosperity and development made Tang Dynasty of ancient China a famous empire with unprecedented prosperity in ancient feudal economy. It is clear that ecological protection idea and environmental protection measures of the Tang Dynasty played significant roles in economic development.

In Song Dynasty (960–1279 AD) and Yuan Dynasty (1271–1368 AD), especially North Song Dynasty (960–1127 AD) of ancient China, the governments paid great attentions to make legislation and law on natural resources and eco-environmental protection. The governments promulgated decrees several times with aims at protecting mountains, forests, vegetation, rivers, lakes, bird, mammals, fish, and turtle. The governments of Ming Dynasty (1368–1644 AD) and Qing Dynasty (1644–1911 AD) in ancient China copied mostly the acts and laws of Tang Dynasty to protect the natural resources and eco-environment.

### *2.1.3 Development of Institutions for Natural Resource and Environment Protection*

*Yu Heng* was the internal institution of feudal dynasty in ancient China, responsible especially for the administration of mountains, forests, rivers, and lakes. This institution functioned in developing and implementing the relevant policies for protecting and utilizing the natural resources such as birds, animals, fish and turtles, wild fruit trees and vegetables in mountains, forests, rivers, and lakes in a sustainable manner. Collecting (fruits, seeds, etc.) and hunting were permitted by this institution only in certain seasons. Collecting and hunting were banned at the time when fish, mammals, and trees were on breeding and reproducing (Figs. 2.7 and 2.8). The name, rank and responsibility of *Yu Heng* varied slightly among different dynasties. The names of *Yu Heng* varied as *Shan Yu* (responsible for governing mountains), *Ze Yu* (responsible for governing lakes), *Ye Yu* (responsible for governing wildland), *Shou Yu* (responsible for governing wildlife), *Shui Yu* (responsible for governing water), and so on, in terms of natural environments they are responsible for.

According to the record in the book of *Shang Shu* (the history of Shang Dynast), the earliest Yuheng in China appeared in Emperor Shun period, and the first Yu official is Bo Yi. The Yuheng system in Zhou Dynasty was recorded in *Zhou Li* with clear description of the official post and functions of Yuheng. In Qin Dynasty and Han Dynasty, Yuheng was called Shaofu, which was still in charge of mountains, forests, rivers, and lakes. In Sui Dynasty and Tang Dynasty, the functions of Yuheng were further expanded with wider administration scope. According to the record of *Jiu Tang Shu* (the history of Shang Dynast), “the post of Lang Wai Yuan Zhong Lang in Yubu is in charge of planting along the streets and lanes in capital, mountains, rivers, lakes, gardens, grass, trees and firewood, farmland and hunting. Collecting, grazing, fishing and hunting shall be at the right time. No collection and hunting are permitted within 150 km with Jingzhao City and Henan City as centers.”

**Fig. 2.7** Drawing of *Yu Heng* official judging the case (photo by Shikui Dong)

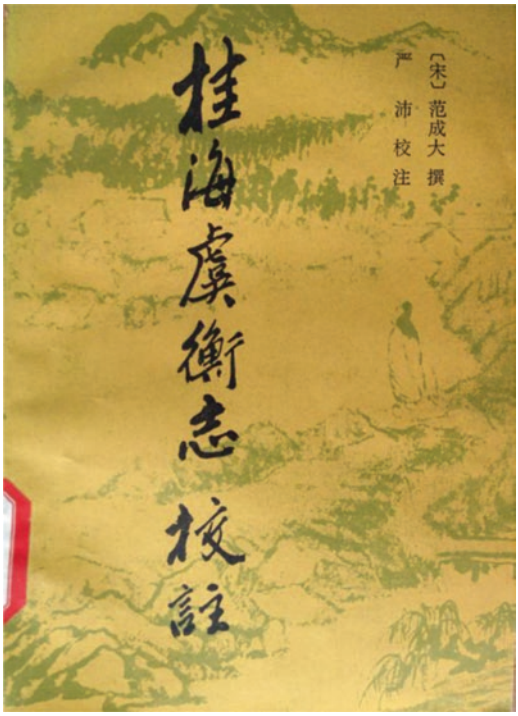


**Fig. 2.8** Modern copy of *Yu Heng* history in Guihai (photo by Shikui Dong)

According to the book "History of Song Dynasty," the responsibility of Yubu included mainly implementation of government decrees on mountains, forests, rivers, lakes, pastures for raising animals, mining, and smelting. The responsibilities of Yuheng in Ming Dynasty recorded in the book "History of Ming Dynasty" also included protection of agricultural lands and historic scenic places. The responsibilities of Qinlisi of Yuheng in Qing Dynasty were similar to those in Ming Dynasty.

In sum, it can be concluded Yuheng system of ancient China combined the environmental protection with socioeconomic development, and should be the embryonic form of harmony between protection and development, which has some implications to improve environmental protection nowadays.

### *2.1.4 Environmental Destructions and Problems in Historical China*

Although ancient Chinese have developed very good ecological wisdoms (environmental protection thoughts), environmental protection laws and regulations, environmental governing institutions, there were also some environmental problems in Chinese history, especially modern China. Several cases showed that inappropriate human activities such as stationing troops at bordering areas, hunting, elaborate funeral and construction of palaces in ancient times led to destruction of massive forests and grassland. The famous ancient poet Du Mu (803–852 AD) in his prose *Er Pang Gong Fu* described that all trees on Mount Shu were cut down to construct Epang Palance with the order from Emperor Qin Shihuang (Fig. 2.9). Although there was some exaggeration, this description indicated the destructive deforestation at that time. It can also be seen from the tomb paintings of Han Dynasty unearthed in Yan'an that vegetation cover of the Loess Plateau was good from Western Zhou Dynasty to Han Dynasty. However, the Loess Plateau with rich vegetation and wildlife had been turned into barren hills due to replacement of grasslands by farming lands after Han Dynasty, leading to serious water and soil erosion, which was lasting till to modern era.

The environmental problems in more recent history of China (Ming and Qing Dynasties) were mainly degradation and deterioration of ecological environment due to expansion of human activities. In the Loess Plateau, farmers losing land migrated to the northern slope areas of Qing Ling Mountain due to rapid population growth and they destroyed a lot of forests for reclaiming the farming lands. When the land became infertile after several years, they abandoned and moved to the new lands. This practice lasted year after year. As a result, most forests in mid and upper reaches of the Weihe River and forests in northern Shaanxi, Inner Mongolia, and Shanxi Province were destructed in the end of Qing Dynasty (early twentieth century). The forests in Beijing and lower reaches of the Xiangjiang River (Pearl Delta) in Southern China were also destructed in that period. Timber consumption for construction of palaces and logging for resident's firewood in Beijing in Ming

**Fig. 2.9** The relics of Epang Palace (photo by Shikui Dong)

Dynasty and Qing Dynasty nearly depleted forest resources in Western Mountain areas in Beijing. As a result of forests destruction in key watershed regions, water and soil erosion, land desertification became the serious environmental problems in the short term.

In Chinese modern history, which refers to the historical period from the Opium War (occurred in 1848 AD) to the foundation of People's Republic of China (in 1949 AD). It was the period when Chinese society was suffering from natural and man-made calamities, foreign invasion, political instability, and many difficulties. During that period, population of China grew rapidly, while arable land area did not change very much. Rapid population growth exceeded the land productivity and carrying capacity of eco-environment; thus, deforestation and land-use changes became inevitable. With the development of modern agricultural production technologies, human beings altered greatly the capacity in interfering with natural environment at larger scale. The adverse impacts of population growth on the environment became increasingly obvious, gradually making the relations between population and the environment in vicious circle. In addition, the invasion and plunder of imperialist countries aggravate environmental deterioration of China. For example, the invasion of the Czar Russia and Japanese imperialism in northeastern part of China led to predatory logging and destruction of the virgin forest resources in this region in late nineteenth century to early twentieth century. The findings of many scholars' studies on environmental history show that the development of grassland desertification in northwest part of China and mountain environment degradation in eastern part of Guangdong Province in Southern China and mountainous areas of Yunnan Province in Southwestern basi-

cally began in Ming Dynasty and Qing Dynasty, accelerated in the mid and late nineteenth century. Ecological environment of modern China suffered greatly from serious water and soil erosion, land desertification, frequent natural disasters, and loss of biodiversity due to many drivers such as rapid population growth, damage of forest and grassland vegetation due to agricultural activities, excessive development of mineral resources, wars, and political instability.

During the period of Republic of China (1911–1949 AD), agricultural economy dominated socioeconomic system, although there was some development of modern industry in coastal regions. At that time, China was semicolonial and semifeudal society with turbulent political situation and frequent wars. The government was too poor and weak to pay much attention on environmental protection. Environmental pollution resulting from industrial production caused serious natural resources degradation and water and soil erosion in some coastal regions. There were hardly any laws and regulations on preventing and controlling pollution. The government promulgated only several laws on conservation of natural resources such as Fishery Law (1929 AD), Land Law (1930 AD), Forest Law (1932 AD), Poaching Law (1932 AD), and Water Resource Law (1942 AD). Indeed, these laws didn't function well in natural resource and environment management due to poor implementation. In addition, in the revolution bases ruled by Communist Party of China (CPC) before foundation of People's Republic of China (1949 AD), the Red government developed and implemented some regulations on protection of natural environment such as Act of the Soviet Area in Western Fujian Province on Nature Conservation of Mountains (1930 AD), Measures of Shanxi-Chahar-Hebei Border Area on Conservation of Mountain Vegetation (1939 AD), Regulations of Shanxi-Chahar-Hebei Border Area on Reclamation of Wasteland (1938 AD), Regulations on Shaanxi-Gansu-Ningxia Border Area on Forest Protection (1941 AD), Regulations of Shanxi-Chahar-Hebei Border Area Construction of Rural Water Conservancy Facilities (1943 AD), and Provisional Regulations of Liberated Area of Northeast China on Protection of Forests (1949 AD). These legislations on natural resources aimed to develop economy and ensure sustained use of resources. However, due to impacts of anti-Japanese war and War of Liberation (Civil war), these regulations were not been effectively implemented and natural environment in those regions were not well protected.

## 2.2 Practice and Challenges of Environmental Management in Contemporary China

Although environmental issues in China can be traced back to 2000 years ago, the environmental destruction did not badly affect the people's lives in the history due to ancient Chinese's ecological wisdoms, which stressed the harmony between human and nature. Since the foundation of People's Republic of China (in October of 1949), contemporary China experienced undergoing economic, social, and environmental changes unprecedented for any nation at any time in world history. The development

model of economic development prioritized over environmental protection associated with population, social transformation, political changes, and land-use change in contemporary China has increasingly accelerated environmental deterioration, making China as some of the most polluted skies and waterways in the world (He et al. 2012). However, poor environmental governance across different social–political transformation periods of contemporary China has intensified the environmental problems. In the development of environmental governance in contemporary China, four phases can be distinguished in terms of social–political transformation features. Phase I lasted from 1949 to 1971, which was characterized as No Environment Governance, Severe Environment Damage. Phase II from 1972 to 1991, which was characterized by Growing Environment Governance, Increasing Environment Damage. Phase III from 1992 to 2011, which was characterized as Strengthening Environment Governance, Decreasing Environment Destruction. Phase IV from 2012 onward, Prioritizing Environment Governance, Minimizing Environment Destruction.

### *2.2.1 Phase I (1949–1971): No Environment Governance, Severe Environment Damage*

When People's Republic of China was established in October of 1949, the nation followed Soviet-style plans for rapid development of heavy industry, which caused a serious of environmental problems in whole country. The rapid development strategy of Soviet style totally eroded Chinese traditional ecological belief "Harmony between Human and Nature." As stated by Shapiro (2001) in her book "Mao's war against Nature": "Numerous campaigns suppressed elite scientific knowledge and traditional grass-roots practices concerning the physical world, stifling dissent through political labels, ostracism, and labor camp sentences… Less well known is their effort to reshape the nonhuman world, with severe consequences both for human beings and for the natural environment." In late 1950s, Anti-Rightist Movement discouraged and even suppressed many experts who were concerning much about the sustainable development. For example, the famous economist Ma Yinchu who cautioned against unchecked population growth, and the hydroengineer Huang Wanli who opposed the Sanmenxia Dam on the main stream of the Yellow River were overthrew as the Rightists. Actually, many evidences show the overpopulation in late 1950s intensified struggles over land and resources and Sanmenxia Dam project was an environmental and economic mistake (Shapiro 2001). In February of 1958, Central Committee of Chinese Communist Party and the State Council of China released the instructions "Eliminating four pests (rats, sparrow/bug, Mosquito and flies), keeping the hygiene." A lot of chemicals applied to control these "pests," which caused the serious destruction of natural ecosystem (Fig. 2.10).


**Fig. 2.10** Drawing of movements for eliminating four pests, rats, sparrow/bug, mosquito, and flies (photo by Shikui Dong)

During 1958–1960 Great Leap Forward, urgency to achieve utopian socialism without planning led to massive environmental problems and widespread human starvation. As stated by Shapiro (2001) in her book "Mao's War Against Nature": "With urgent tasks of overtaking Britain in steel production within 15 years, as a lot of trees were cut to fuel 'backyard furnaces' for steel smelt, leading to widespread deforestation… Despite limited success in water conservancy and irrigation projects, huge hydropower projects removed millions from their homes but were useless or caused disastrous floods when poorly constructed dams broke…Fanciful agricultural schemes and competitions to produce impossible yields by combining rural collectives into vast People's Communes sapped farmers' energy, impoverished the land's productivity, and contributed to the greatest human-made famine in history." Decreased land productivity, increased population, massive food waste, together with natural disasters contributed to the greatest famine in China, from which many people died (Dikötter 2010). As people starved throughout China, living creatures on whom they depended were hunted down and eaten. "There were no birds left in the trees, and the trees themselves had been stripped of their leaves and bark" stated by Dikötter (2010) in his book "Mao's Great Famine."

During the Cultural Revolution in late 1960s and early 1970s, the coercion and chaos associated with massive political movements led to the collapse of national

economy and the degradation of ecosystem and environment. Suffered from the great famine in Three Hard Years (1959, 1960, 1961), the national set the feeding China's growing population as the first priority, and "Take Grain as the Key Link" [*Yi Liang Wei Gang*] dominated the national development strategies. To increase the grain production, the nation launched the project of "Learning agricultural production from Dazhai (model)" [*Nong Ye Xue Da Zhai*] in whole country without thinking about the differences of topography and climate across the regions. Encouraged by the spirit of "Old Man" in an ancient Chinese Tale "The Foolish Old Man Who Removed the Mountains," a story about the effectiveness of concerted manual labor, many people were involved in earth-transforming campaigns to reshape the physical world radically within short time. A lot of improper land reclamation slogans, as stated Shapiro (2001), were invented to include a range of geographic possibilities: "Encircle the rivers, build land" [*weihe zaodi*]; "encircle the lakes, build farmland" [*weihu zaotian*]; "destroy the forests, open the wastelands" [*huilin kaihuang*]; "on steep slopes, open the wastelands" [*doupo kai huang*]; "destroy the pasturelands, open the wastelands" [*huimu kaihuang*]; "on flat-lands, construct terraces" [*pingyuan zao titian*; "plant sprouts in the center of lakes" [*chayang cha dao huxin*]; "Squeeze land from rock peaks, get grain from rocks" [*cong shitou fengli ji di, xiang shitou yao liang*]. These misbehaviors produced some disastrous environmental consequences such as landslides, erosion, flooding, desertification, drought, and biodiversity loss. Most importantly, these disastrous movements have devalued and in some cases eliminated indigenous knowledge and practices with great ecological wisdoms among ethnic communities (such as Dai, Yi, Naxi, Tibetan in Southwestern China), who have effectively managed their environment by using indigenous knowledge and practices over a long time (Xu et al. 2005)

During the war preparation campaign of the late 1960s and early 1970s, the strategic industries were transferred by administrative fiat to the interior to form a defensive "Third Front" against the American "imperialists" and Russian "revisionists," millions of "educated youth" in urban areas were sent to the countryside and frontiers for farming and construction (Shapiro 2001). The urban people were forced to migrate into the wild lands or sparsely populated lands which they were not familiar of had no connections, and these relocated urban people were induced to reclaim the wild lands and resulted in the impoverished land productivity and the degraded natural environments (Shapiro 2001). The earth-transforming campaigns of land reclamation such as "destroy the forests, open the wastelands" [huilin kaihuang], "destroy the pasturelands, open the wastelands" [huimu kaihuang], "plant sprouts in the center of lakes" [chayang cha dao huxin] were continued without consideration of environmental costs. In the leadership vacuum that followed Red Guard attacks on government officials and scientists (Shapiro 2001), natural resources became more and more overexploited as the poem said:

"Let's attack here!
Drive away the mountain gods,
Break down the stone walls
To bring out those 200 million tons of coal.
Let's strike here!
Let the Dragon King change his job,

Let the river climb the hills,
Let us ask it for 8000 *mu* (533 ha) of rice paddies.
Let that valley open its bosom
To yield 500 *jin* (250 kg) (half kg) of oats every year.
Cut down the knoll
To make a plain over there…
Let's wage war against the great earth!
Let the mountains and rivers surrender under our feet.
March on Nature,
Let's take over the power of rain and wind.
We shall not tolerate a single inch of unused land!
Nor a single place harassed by disaster.
Make wet rice, wheat, and yellow corn grow on top of the mountain,
And beans, peanuts, and red gaoliang rise on rocks…"
—Zhang Zhimin, *Personalities in the Commune*

During the war preparation campaign, massive infrastructures such as railroads were built by ignoring resource overexploitation and labor cost, resulting in serious environmental problems and economic loss. Industries were promoted in rural areas as a way to eradicate social differences, carry out a policy of regional and national self-reliance, and protect national security; however, air and water pollution were becoming serious environmental problems.

### *2.2.2 Phase II (1972–1991): Growing Environment Governance, Increasing Environment Damage*

Before United Nations Conference on the Human Environment (UNCHE) was held in Stockholm of Sweden in 1972, China was under the influence of left socialism, in which the prevailing ideology was to reject western capitalist countries' development strategies with the belief of "no pollution in socialist countries." At the beginning, Chinese government was not going to send any delegations to the UNCHE. Fortunately, former Premier Zhou Enlai realized the seriousness of environmental problems derived from coercion and chaos during Culture Revolution in later 1960s to early 1970s. He insisted to send a delegation to Stockholm of Sweden for attending the UNCHE. After this conference, China's State Council held the First National Conference on Environmental Protection in August of 1973, forwarding the environmental policy of "Overall plan, appropriate layout, comprehensive use, recycling waste, depending on the public, public participation, protecting environment and benefiting the people." However, little progress was actually made in environmental protection across whole nation. For example, land desertification in arid and semiarid China was dramatically increasing every year from 1970s to 1990s, the potential lands threatened by desertification were 2,566,000 $km^2$, accounting for 26.7 % of nation's territory in late 1990s.

In December of 1978, just after end of Culture Revolution, new leader in China, Deng Xiaoping made a remarkable address "Emancipating the mind, seeking the truth from the facts and uniting as one in looking forward to the future" at the Third

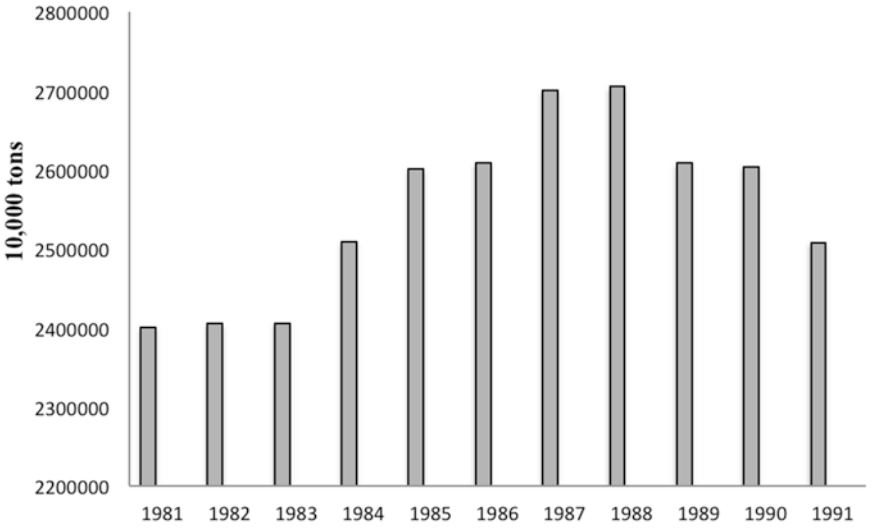


**Fig. 2.11** Industrial wastewater discharges from 1981 to 1991 (sources: NBS. 1981–1991. *China Statistical Yearbook 1981–1991*)

Session of the 11th Central Committee of the Communist Party of China (CCCPC). At the 11th CCCPC, Opening-up and Reform were defined as key approaches to achieving the goal of Socialist Modernization Construction /Economic Development. The rapid economic development with China's Opening-up pushed the people turn toward materialism, short-term profits, and environment-unfriendly life, which resulted in rapid and unsustainable exploitation of natural resources and massive discharge of waste (Fig. 2.11), growing land degradation, and increased environment pollution in urban areas. Meanwhile, the population control policy led to a rapid increase of rural population, which greatly increased the pressures on rural environments. Environmental pollution and ecosystem degradation associated with nationwide industrialization and quick population growth challenged the sustainable development of the nation, although China made great efforts in policy instruments, science and technology, and public participation to promote the environmental protection.

### *2.2.3 Phase III (1992–2012): Strengthening Environment Governance, Decreasing Environment Destruction*

Just after United Nations Conference on Environment and Development (UNCED), which is also termed as Earth Summit or Rio Summit, was held in Rio de Janeiro of Brazil in June of 1992, the Chinese government defined the sustainable development as a national development strategy. With the objective of sustainable

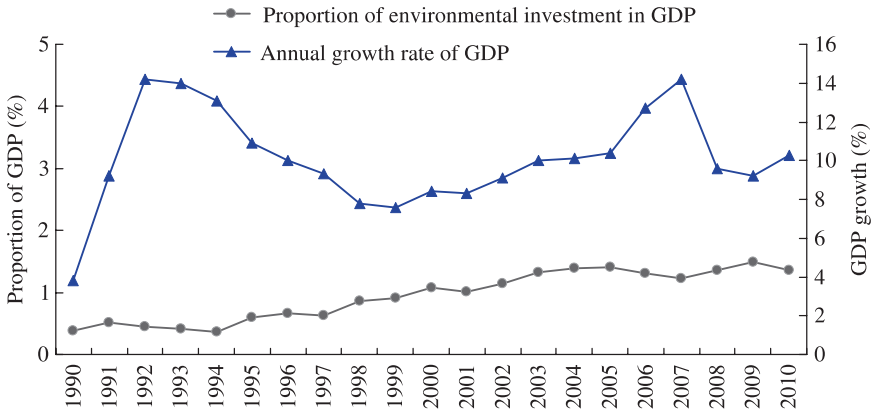


**Fig. 2.12** China's growth rate of GDP and proportion of pollution control investment in GDP, 1990–2010 (*source*: He, 2012; data were collected from China Environmental Yearbook Committee (1991–2011))

development, China made great efforts to develop the Agenda 21, the action plan for sustainable development. In March of 1994, China released Agenda 21, which was defined by State Council of China as the guideline for mid- and long-term planning of national economic and social development government at all levels. With the implementation of China's Agenda 21, the government strengthened the Environmental Impact Assessment system on major projects and planning before implementation. Meanwhile, the Chinese government took numerous countermeasures to mitigate environmental impacts of social and economic development. In 1996, the State Council of China held the Fourth National Conference on Environmental Protection and released the Decision on Some Issues of Environmental Protection. With the rapid growth of National GDP, the Chinese government invested a great amount of money to initiate environmental protection projects and programs (Fig. 2.12). In late 1990s, the Chinese government started the control of total discharge of major pollutants and industrial wastes to meet national emission standard and environmental quality of different functional zones of major cities. At the same time, the Chinese government initiated some pollution control programs knows as "33211 Project" [33211 gongcheng], which included water pollution controls for "3 Rivers" (Huaihe River, Haihe River, and Liaohe River), and "3 Lakes" (Taihu Lake, Dianchi Lake, and Chaohu Lake), air pollution controls for "2 Control Zones" (Acid rain control zone and $SO_2$ control zone), "1 City" (Beijing city), and "1 Sea" (Bohai Sea). At the end of twentieth century and the beginning of twenty-first century, the central and provincial governments of China launched a series of ecological protection projects such as "Natural Forest Protection" [tianranlin baohu], "Returning cultivated slope lands into forest and grasslands"[tui gen huan lin huan cao], "Returning Cultivated Lands into Wetlands and Lakes"[tui tian huan hu], "Retiring Livestock, Returning Grassland" [tui mu huan cao], etc., to mitigate the ecosystem degradation.

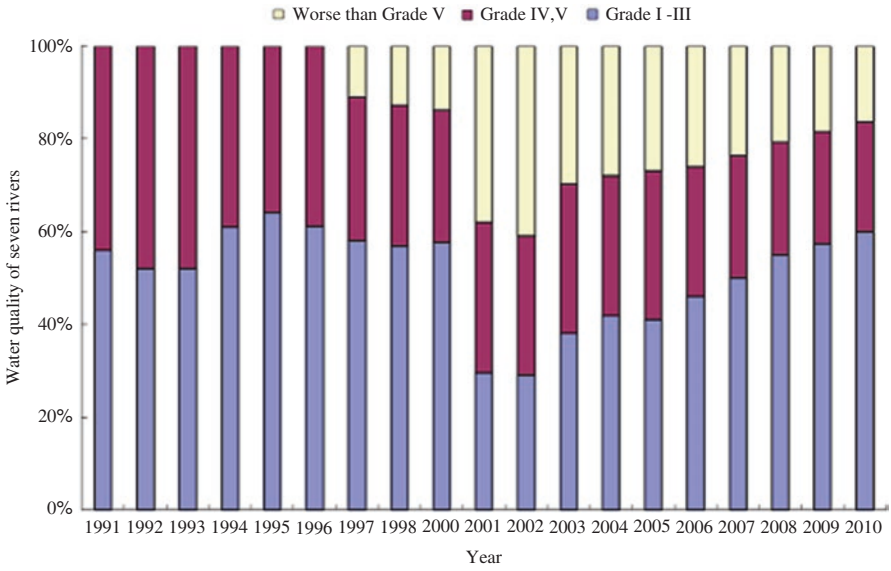


**Fig. 2.13** Water quality of seven rivers (Yangtze River, Yellow River, Pearl River, Songhua River, Huaihe River, Haihe River, and Liaohe River) in China, 1991–2010 (*source*: He, 2012; data were collected from MEP Report on the State of the Environment in China, 1991–2010). Note: According to Environmental Quality Standards for Surface Water (GB 3838-2002) in China, the function of surface water is classified into five categories as below. There are five grades of standard value to match the surface water functional area. Grade I stands for the best quality, while Grade V represents the worst

Although the Chinese government made great efforts in environmental protection and sustainable development, the accelerated industrialization, urbanization, globalization, and rapid economic growth brought huge pressures on the environment and natural resources in China. Fast economic development led to severe environment pollution and natural resource overexploitation, which in turn could become barriers to economic development and social stability (Wang 2011). It was stated by the authorities such as China's Ministry of Environmental Protection that environmental condition in China "improved as a whole, but deteriorated partially" [quan mian gai shan, ju bu bian cha] in past decades. According to China's Millennium Development Goals (MDGs) Report (2010), there remained many challenges in natural resource use and environmental protection since 1992 (Wang 2011). The statistic data summarized by He et al. (2012) showed that the air quality was slightly improved as a whole in the past decades, while water quality still remained quite low, e.g., the water quality of seven major rivers in China in 2000s became even worse than that in the early 1990s (Fig. 2.13). The summary from He et al. (2012) also showed that the point-source pollutants of the water (COD, nutrients) and air ($SO_2$, NOx, VOC) were moderately reduced, while the nonpoint-source pollutants of water and air were not lessened. In recent years, air pollution in mega cities like Beijing became more and more serious. In 2010, only 3.6% of the 471

major cities in China were recorded for top ratings of clean air according to National Environmental Monitoring reports (Ministry of Environmental Protection MEP 2011). Meanwhile, greenhouse gas (GHG) emissions were dramatically promoted due to increased energy consumption for boomed economic development. According to the report from The Climate Change Group (2007), annually average growth rate of GHG emission in China was around 4 % from 1994 to 2004. During that period, the contribution of carbon dioxide to the total GHG in China increased from 76 to 83 % (Xinhua News 2007). In July of 2010, China went beyond USA to become largest energy consumer and the biggest GHG emitter in the world, the share of China's GHG emissions associated with industrial and agricultural activities rose to 8.33 billion tons, accounting to 10.4 % of the world total (He et al. 2012). Although the growing programs of ecological conservation such as development of natural reserve, restoration of degraded ecosystems, promotion of logging and grazing bans led to increased vegetation cover and primary productivity, most of ecosystem functions such as biodiversity protection, flood control, climate regulation, and cultural maintenance were not improved due to uniformed monoculture plantation, insufficient public participation, low capacity for restoration, and insufficient efforts in afforestation.

### *2.2.4 Phase IV (2012 Onward): Prioritizing Environment Governance, Minimizing Environment Destruction*

To eradicate the serious environmental problems, which limited the sustainable development of China, Chinese government announced a shift to a new development model and a new green governance approach in China's 12th Five-Year Plan (2011–2015). Chinese governments at all levels were calling for circular economy, green economy, and low-carbon economy development in the new era. With the guidance of United Nations Conference on Sustainable Development in Rio de Janeiro of Brazil in Rio in June of 2012 (also called Rio+20 or Rio Earth Summit 2012), the 18th National Congress of Communist Party of China (NCCPC, held in November of 2012) prioritized ecological civilization in the movement toward socialist road with Chinese characteristics and in the processes of economic, political, cultural, and social developments in the nation. With the prioritization of ecological civilization, the revival of ancient Chinese ecological wisdom, severe environmental damages have been gradually reduced in recent years.

## 2.3 Innovations of Environmental Management in China

The environmental degradation has challenged the sustainable development of China, especially in contemporary era, many lessons and experiences have urged China to seek innovative ways to solve the environmental problems. Indeed,

China has made great efforts to take integrated measures and multiple actions to cope with the complex issues of environmental risks since 1972. These efforts can be assorted into institutional innovations of empowering environmental protection agency, political innovations of reforming natural resource and environmental management strategies, economic innovations of adjusting development patterns, social innovations of promoting public participation and technological innovations of developing new approaches for pollution control and ecological restoration.

### *2.3.1 Institutional Innovation: Empowering the Environmental Protection Agency*

There was no national institution on environmental protection until the year of 1974, when the State Council established the first leading institution on environmental protection in China, the Leading Group of the State Council on Environmental Protection, which was composed of the representatives from the State Planning Commission, State Construction Commission, as well as the ministries of industry, agriculture, transportation, water resources, and health. This organization was responsible for developing guidelines, policies, and regulations on environmental protection, reviewing national plan for environmental protection, urging the supervision on environmental protection work of each region and department. Thereafter, the governments of province, autonomous region, and municipality established their environmental protection institutions in the name of Leading Group of Environmental Protection at local level.

In 1982, the Standing Committee of National People's Congress (NPC) issued the Decision on the Implementation Program on Institutional Reform of Ministries and Commissions of the State Council, by which the State Council established the first environmental protection administrative agency, Environmental Protection Bureau under the Ministry of Urban-Rural Construction and Environmental Protection. Accordingly, province, autonomous region and municipality established their Environmental Protection Bureau in the governmental body. This institutional reform ended the history of lacking environmental protection authorities in China over past decades. In 1984, the Circular on Establishment of National Environmental Protection Agency released by the General Office of the State Council and the Environmental Protection Bureau in Ministry of Urban-Rural Construction and Environmental Protection was changed into "State Environmental Protection Agency." However, it was not yet an independent administrative body for environmental protection at the national level. In 1988s Institutional Reform of the State Council issued by NPC, the State Environmental Protection Agency was separated from Ministry of Urban-Rural Construction and Environmental Protection and became an independent government body. The State Environmental Protection Agency was an upgraded vice ministry level administrative agency in charge of overall supervision and administration of envi-

ronmental protection work of the country. Meanwhile, the environmental protection agencies at province, autonomous region, and municipality level were upgraded accordingly. This upgrading strengthened the functions of Environmental Protection Administrations on environmental supervision and management, as the State Environmental Protection Agency appeared as a department under the direct lead of State Council and formed solid organization foundations for the implementation of national guidelines, policies, laws, and regulations on environmental protection.

In 2008, Institutional Reform of the State Council issued by NPC decided to establish Ministry of Environmental Protection to strengthen the overall coordination of policies, plans, and key issues on environmental protection. The main functions of Ministry of Environmental Protection are developing environmental protection plans, policies, and standards and organizing their implementation; supervising the prevention and control of environmental pollution and coordinating the solution to major environmental problems. The newly established Ministry of Environmental Protection becomes a formal member of the executive meeting of the State Council. Like the previous Environmental Protection Agency, Ministry of Environmental Protection kept on unified supervision and administration on environmental protection across the country. In addition, it gained the more responsibilities for enhancement of overall coordination of environmental policies, plans, and major issues; participation in comprehensive decision making on environment and development according to environmental function zoning. Accordingly, all provinces, autonomous regions, and municipalities upgraded their environmental protection agencies as the departments of provincial government responsible for comprehensive decision making for environment and development issues. The process of institutional reform in the past decades has empowered the Environmental Protection Authorities across different administrative levels, which can provide solid and reliable institutional foundations for implementing national and local strategies and programs of environmental protection.

In addition to empowering the administrative institutions, Chinese governments have been striving to develop the legislative institutions in charge of environmental issues, in order to implement or enforce the environmental protection policies and projects more efficiently and powerfully. In 2005, the State Council of China issued a decision on environmental protection, which outlined how China would benefit the creation of specialized court systems for environmental protection and management. Since then, the environmental protection courts/tribunals have been developed gradually from the low to high level in 4-level court systems, grass-root court at county level, intermediated court at district level, high court at provincial level, and supreme court at national level. Till July 3rd of 2014, the environmental protection tribunal was established in the supreme court of China, meaning that the environmental justice in China has been promoted to a completely specialized court system (Xinhua News 2014a).

### 2.3.2 *Political Innovations: Reforming Natural Resource and Environmental Management Strategies*

Environmental protection laws and regulations in contemporary China experienced the process from zero to quite a number of laws and regulations. China developed, enacted, and amended several specific laws on environmental protection and resource laws in relation to environmental protection since 1949. Apart from general requirement for environmental protection in the Constitution, China has developed and implemented nearly 30 laws relating to environmental pollution since 1979 such as Environmental Protection Law (first issued in 1989, revised in 2014 as shown in Fig. 2.14, Environmental Impact Assessment Law (first issued in 2002), Marine Environment Protection Law (first issued in 1999), Law on Prevention and Control of Atmospheric Pollution (first issued in 2000), Law on Prevention and Control of Water Pollution (first issued in 2008), Law on Prevention and Control of Pollution from Environmental Noise (first issued in 1996), Law on Prevention and Control of Environmental Pollution by Solid Waste (first issued in 2004), Law on Prevention and Control of Radioactive Pollution (first issued in 2003), Land Management Law (first issued in 1986, revised in 2004), Water Law (first


**Fig. 2.14** Publication of Revised Law of the People's Republic of China on the Environmental Protection (photo by Shikui Dong)

issued in 2002), Law on Protection of Wildlife (First issued in 2004), Mineral Resources Law (first issued in 1986, revised in 1996), Forest Law (first issued in 1984, revised in 1998), Grassland Law (first issued in 1985, revised in 2002), Fishery Law (first issued in 1986, revised in 2013), Law on Prevention and Control of Desertification (first issued in 2001), Law on Promotion of Clean Production (first issued in 2002), Law on Conservation of Energy and Law on Promotion of Circular Economy (first issued in 2009), accounting for about 1/10 of the total legislations established by National People's Congress and its standing committee.

Meanwhile, the State Council has also developed over 60 administrative regulations on environmental protection to facilitate law implementation or fill out vague blank of laws. To carry out national laws and administrative regulations on environmental protection, relevant departments of the State Council, local people's congress, and local governments have developed and promulgated over 600 environmental regulations and local regulations based on their functions. China has developed large amount of environmental standards to support the implementation of these environmental laws and regulations. Up to November 23, 2010, China had released a total of 1397 various kinds of national environmental standards, including 1286 existing national environmental standards and 111 nullified standards. With establishment of complete environmental laws and regulations, enhancement of environmental law enforcement and justice as well as public participation in many channels, China has partly curbed and mitigated environmental pollution and ecosystem degradation with Rapid economic growth over past decades.

With fast social-economic transformations, many environmental problems have intensive outbreak in very short period in China, leading to the failure of environmental protection laws in meeting current demands. To this end, China has conducted relatively frequent amendments of environmental protection laws. For instance, China has completed the revision of 1989s Environmental Protection Law into "The Strictest Environmental Law in the World" in April of 2014 (Xinhua News 2014b). With these amendments, environmental protection laws of China are adapting to practical requirements, improving legislation quality and enhancing their relevance and effectiveness. These laws and regulations have been playing important roles in constraining activities on damaging natural resources and resulting in environment pollutions.

### *2.3.3 Social Innovations: Promoting Public Participation in Environmental Management*

Serious environmental problems have not only promoted the Chinese governments to strengthen the environmental supervision and management through improving institutional and political instruments, but also motivated a lot of civil societies to participate in environmental protection. A growing numbers of environmental non-government organizations (ENGOs) appeared like "bamboo shoots after spring rain" [yu hou chun song] to appeal the environmental movements and protections

across the nation. From 1994, when the first Chinese ENGOs, Friends of Nature were founded in Beijing, to 2008 when the Olympic Game held in Beijing, China, the numbers of ENGOs were increased to over 4000 and the capacity of ENGOs were empowered to monitor the governmental activities on environmental protection. Currently, All-China Environment Federation is a top Chinese ENGOs, which plays important roles in leading public environmental movements. These Chinese ENGOs, along with international ENGOs, mobilize the publics to protect the environment and conserve the natural resources, launch volunteer activities to stop any activities of companies and industries that may damage or destruct the environment, supervise and monitor the government-led environmental movements such as environmental impact assessment, environmental policy implementation, etc., facilitate and execute public educations on environmental protections.

Grass-root people's participations have been promoted in recent years with the launching of new concept of "Ecological Civilization" advocated by Chinese government. The values of indigenous knowledge and traditional practices on protecting land, forests, and water catchments, preserving biodiversity and recycling resources through religious beliefs, inherited traditions, and cultural practices have been assessed and advocated by Chinese government. For example, the Organic Law of 1998 granted villages the legal right to self-government and gave indigenous communities greater responsibility for land and resource use. The relationship between natural environment and indigenous people has been integrated within religious, moral, cultural, political, economic, and ecological boundaries in government planning, e.g., timber trees have been protected and were harvested only with village consent, upstream vegetation was preserved by local people, and grassland grazing was monitored by the pastoral community (Xu et al. 2005).

In addition to civil societies and grass-root communities, medias are playing more and more important roles in supervising government environmental activities, promoting the public environmental movement. With increasing public participation in environmental protection, China has been continuously promoting publicity and popularization of scientific knowledge on environmental protection, encouraging broad-range public participation in environmental movements, strengthening school and nonschool education to raise public awareness and advocate the whole society to protect environment by adapting environment-friendly behavior and low carbon life style.

### *2.3.4 Technological Innovations: Developing new Approaches for Pollution Control and Ecological Restoration*

China has developed innovative technologies on resource and energy saving, resource circular use, zero emission in industrial chain, natural resource protection, and ecological restoration. In the tenth (2001–2005) and 11th Five-Year Plan (2006–2010) periods, the Chinese government took energy saving and emission reduction as a key indicator in assessing national economic and social development

and developed a series of innovative technical measures on reducing total emission of pollutants and mitigating ecological degradation. The official data show that there were about 59, 72, 42, 55, and 39 % of decreases in the discharges of industrial sewage, COD, $SO_2$, Smoke, and Dust for per GDP in 2004, in contrast to 1995. In 2010, the total discharge was 12.381 million t for COD and 21.851 million t for $SO_2$, going down by 12.45 and 14.29 % in comparison with those of 2005. In whole nation, the cities with air quality better than Grade II increased about 31 % and those with air quality worse than Grade III decreased 39 % from 1996 to 2005. There were about 810, 000 $km^2$ of newly protected watersheds along major rivers and lakes for clean water production from 1995 to 2006. In whole country, the forest cover increased from 13.92 % in 1993 to 20.36 % in 2008. Up to the year of 2008, 20 % of degraded grasslands have been restored and land desertification have been reduced by 245, 900 $km^2$. Till the year of 2012, 2349 Nature Reserves (parks) have been established with a total area of 1500,000 $km^2$, accounting to 15 % of total nation's lands. Around 85 % of nation's territorial ecosystems and 85 % of wildlife and 65 % of native vegetation have been well protected. Through technological innovations, great achievements have been made to improve country's environment and promote the nation's sustainability.

### *2.3.5 Economic Innovations: Adjusting Development Modes and Patterns*

To reduce the risks of environmental pollution and ecological degradation, the Chinese government attempted to transform the extensive economic development mode featured as "high consumption of energy and resources, high emissions of pollutants and GHG" into the intensive one characterized as "low consumption of energy and resources, low emissions of pollutants and GHG." The experiences show that transformation of the traditional economic development mode in China was key solution to mitigate the contradictions between economic growth and natural resources and environment protection. At the 17th National Congress of Communist Party of China (NCCPC) in October of 2007, the concept of "Scientific Development" was defined to create an "environment-friendly" society in China through adjusting the development modes. The 17th NCCPC highlighted to take environmental protection as an important means for adjusting economic structure; transforming economic growth mode; and achieving sustained, healthy, fast, and coordinated economic development. Since then, China has made more efforts in industrial structure adjustment and facilitated industrial upgrading, firmly curbed too fast growth of the industries with high energy consumption and high emissions. Since 2009, development of green economy has been integrated into China's development strategy. To address the problems of high-energy consumption and heavy pollution, China has made more efforts in developing clean energy industry, renewable energy industry, and environmental industry. Taking circular economy as an important instrument for adjusting economic structure and transforming development mode,

China has explored effective modes for enterprises, group business, or industrial parks and society to develop circular economy. China has accelerated the development of resource recycling and reuse industries; strengthened comprehensive utilization of mineral resources; promoted recycling and reuse of industrial wastes; improved renewable resource recycling system and facilitated commercialization of recycling and reuse of resources. Development of low carbon economy is being experimented in China for economic structure adjustment and development mode transformation. China has released comprehensive policy documents to guide the development of low carbon economy and publicizing policy potential in guaranteeing the development of low carbon economy. China has carried out local and regional action plans for developing low carbon economy, e.g., development of renewable energy such as hydropower, wind energy, biomass, and solar energy with clean use of coal.

**Acknowledgements** The author acknowledge the funding organizations including Ministry of Science and Technology of the People's Republic of China (Grant no. 2016YFC0501906), National Natural Science Foundation of China, and Asian Scholar Foundation, India China Institute of New School, Beijing Normal University for their financial supports. The author grateful to the scholars whose articles, tables, and figures are cited in this chapter.

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# Chapter 3
# Environmental Struggles and Innovations in India: An Historical Perspective

**Jayanta Bandyopadhyay**

**Abstract** An historical account of environmental transformations in India, with drivers of such changes, is presented in this chapter. The account starts from the period of the Indus Valley Civilization and ends in the situation in present-day India, especially the period of high rates of economic growth in the past two decades. The main driver for environmental change was growth in population caused by both in-migration and natural growth, while the main environmental change was deforestation for agriculture, and to a lesser extent for expanding human settlements. There have been numerous environmental struggles as a result. At a later stage, water systems were transformed to expand irrigation and water supplies. The chapter identifies two significant innovations based on and prompted by environmental struggles. The first innovation was the community-based resistance to commercial forest felling in the present-day Indian state of Uttarakhand where, in the early 1970s, local people opposed the practice of appointment of wealthy private contractors from faraway cities for felling of forest trees, mainly for large paper and pulp industries. Instead, the movement wanted community-based controlled felling to feed local timber- and resin-based small industries. In 1974 the common people of village Reni, especially women, took the innovative step of nonviolent obstruction to forest felling by a contractor. The second innovation described in the chapter is on the introduction of the Public Interest Litigation (PIL) by the Supreme Court of India. This innovative step has significantly helped strengthening of environmental justice in India.

**Keywords** Environmental changes in India • Judicial innovation • Medieval transition • Social innovations • Sustainable environment • Vedic period

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S. Dong et al. (eds.), *Environmental Sustainability from the Himalayas to the Oceans*, DOI 10.1007/978-3-319-44037-8_3

## 3.1 Environmental Changes in India: From Ancient Time to the Post-Colonial Period

### *3.1.1 From the Vedic Period Onwards*

The area that has historically been understood as India is quite larger than the area covered by the post-colonial nation state of the same name born in 1947. The erstwhile region generally understood as India in a civilizational sense is better described as South Asia of today. Historians have identified the Harappan or Indus valley (in present-day Pakistan) culture as a remarkable aspect of civilization in that area (Possehl et al. 1989; Singh 1995). Since that period, that can be called the Vedic age, for over about five millennia, the relationship between the humans and their immediate natural environment has been dynamic, ranging from being symbiotic (Somvanshi 2006; Weber 2003) to predatory. The Vedas (2500–1500 BC), especially *Rig Veda*, offer a number of ecological insights that the current scientific knowledge and literature on environmental sustainability would echo. For example, a verse from the Rig Veda would say that, "the sky is like father, the earth like mother and the space as their son. The universe consisting of the three is like a family and any kind of damage done to any one of the three throws the universe out of balance" (Renugadevi 2012: 1). In Vedic scriptures one also finds a clear visualization of the earth's ecosystems with emphasis on maintaining their balance. Another verse from Rig Veda says: "Thousands and hundreds of years if you want to enjoy the fruits and happiness of life, then take up systematic planting of trees" (Renugadevi 2012). Yet another verse says: "Rivers occasion widespread destruction if their coasts are damaged or destroyed and therefore trees standing on the coasts should not be cut off or uprooted" (Renugadevi 2012).

In the absence of an equivalent of an informed civil society as seen in present-day industrialized societies, important changes in the environment have often been related with policies of the clans and rulers as well as broad ups and downs in the lives of the civilizations. For instance, the recent research conducted by Dixit et al. (2014a) indicates that the changes in the climate were one of the most potent reasons behind the decline of the Indus Valley civilization, on which a more detailed analysis has been made by Lahiri (2000).

The Vedic settlements attracted new inhabitants, who kept coming from the north and northwest, over centuries in search of greener pastures in the *Sapta-Sindhu* region, a region of seven rivers in the northwestern parts of the subcontinent (Saxena 1972; Radhakrishna 1999; Dhavalikar 2007). The early Vedic texts mention about their living standards, conflicts, methods of worship and various caveats of subsistence pattern (Sharma 2006; Jha 1998). These texts mention terms like *Gopati* (owner of cattle), *Duhitri* (daughters who milch the cows), *Aditi* (Mother of the Gods), *Indra* (God of water), *Varun* (God of wind), *Agni* (God of fire), etc. which relate to the natural environment and the pastoral cattle wealth. At this stage very few food crops find such a significant mention, which points towards their pastoral and semi-nomadic lifestyle (Gupta 1991; Thapar 1970). In the later Vedic texts, the

number of reference to food crops increased and newer deities were associated with many other functions of life. All this newer knowledge was gained through the growing interaction of humans with nature (Chakravarti 2009; Biswas and Arun 2007). The archaeological evidences and emergence of terms like *Bhupati* (owner of land) indicate a shift in the focus of the economic activities towards greater availability of land and practice of settled agriculture. This also marks the dawn of proprietary relationship with land (Chakravarti 2009; Prakash 1964; Dhavalikar 2007). Interestingly, in Kashmir, in the prehistoric times, domesticated dogs, who guarded the animal wealth, were buried beside their masters. Over centuries, the role of the dogs became limited only to guarding the periphery of the habitat of their masters (Pande 1970; Thapar 1985; Sharif and Thapar 1992; Russell 2002; Higgs 1976). These developments are the indicator of a slow but gradual shift in human's relation with the natural environment and the way they dealt with it. The stories from the *Upanishads* have also indicated about the conflicts between humans and nature per se, where the superiority of symbolic Gods like *Agni, Varun, Indra and others* faced growing challenges from human's ability to transform and use the natural environment (Rogers 1993; Iyengar and Radhakrishna 2007; Hara 2009; Aurobindo 1998). For instance, the *Brihadaranyaka Upanishad*, one of the principal *Upanishad*s in the Vedanta tradition, resonates with the gestalt shift to "relational, total-field image", parting away from the "man-in the environment" image (Rangarajan 2008).

As Jha (1998) has pointed out, in this period clearing of forests was practiced by various clans across the north and the eastern parts of the subcontinent. A strong clan-based system was established by the end of the Vedic age and the human population was on expansive mode in creation of their territorial niche as *Janapada* (Basant 2008; Ahmed 1991; Chakrabarti 2000). This system provided both the social security and supported the sustenance needs of the inhabitants (Misra and Misra 2007; Sahi 1999; Kumaran 2014). The texts like *Ramayana* and *Mahabharata,* which were compiled sometime between 300 BC and 200 AD*,* elucidate the pace of *second urbanization* in the subcontinent led by the use of iron (Ahmed 1991). The epic *Ramayana* is profuse with such evidences. For instance, a manuscript of *Ramayana* holds the picture of coronation of Lord Ram with a variety of tools and weapons made of iron. This not only tells about the names and types of tools used by the people at that time but also the range of application of such tools. These were possibly made up of iron or some of its alloys with sharp pointed stylus for engraving and hatchet for cutting leaves from trees or in agricultural applications (Meher 2009). Rangarajan (2011) points towards the vast fauna through an instance from the epic *Ramayana* that "When Ram was set for his exile, his mother Kaushalya's fear for his safety was from huge swarms of elephants, lions, tigers, bears, boars or ferocious horned buffalo". Evidences of anvils, bellows, hammers, etc. and newly coined terms like *kudalika* indicate growing use of iron that heralded a rapid clearing of forests and expansion of agriculture. A similar legend on the uses of iron tools is mentioned in the texts like *Vishnu Purana* and *Skanda Purana*, describing Sage Parashurama, standing atop the Western Ghats hills in the western coastal parts of India with his iron axe (Chandran 1997). A similar picture of forest destruction is seen in the case of *Khandava Dahana* as a large forest area was set on fire, to burn not only the standing vegetation but also

the living beings in it, including humans, to create clear land for the proposed new capital city for the *Pandava*s.

Supported by good soil fertility and precipitation, agricultural surpluses led to the strengthening of new powerful kingdoms, like that of Magadha. However, the rigid *Varna* system was already established by this time, which paved way for the rise of *Heterodox* sects as a reaction (Gupta 1980; Jha 2014; Ravinder 2003). Buddhism and Jainism were two most important of these heterodox sects (Morrison 1997; Thapar 1975, 1990). These sects acted as a catalyst in cultural synthesis and changed the way the humans perceived and related to the natural environment. Stories of Jataka's and the famous legend of Elephant and the Buddha in the Parileyyaka forest is an indicator of how these heterodox sects tried bringing the humans and the natural environment in a symbiotic frame (Ramanathapillai 2009). Apart from this, many kings, merchants and scholars got influenced by Buddhism and Jainism. They promoted practices that worked for the conservation of nature. At this stage, the popular cult of worshiping trees had emerged, for example the *Aswath* (*Ficus religiosa*) planting of which is an important Buddhist tradition.

The age of Mauryas (322–185 BC) especially under its benevolent King Ashoka (268–232 BC) was an important period where the water security was given priority with excavation of storage lakes and expansion of irrigation. It was also at this time that growing respect for biodiversity can be witnessed. Hunting and deforestation was not done indiscriminately, as part of this concern for sustaining biodiversity. The Mauryan King Ashoka depicted exemplary compassion for wildlife and prohibited killing of certain species of animals (Somvanshi 2006; Tisdell 2005; Gupta 2011). For instance, the concept of conservation of fish in the subcontinent was advocated in 246 BC, the time of King Ashoka (Dubey and Ahmad-Naga 1995). Further, Ashoka established the first ever veterinary hospitals of the world (Iqbal et al. 2008). He along with the new heterodox sects paved way for a more compassionate and symbiotic relationship between the humans and the natural environment.

The period after the decline of the Mauryas saw a series of invasions from the northwest frontiers of the subcontinent which brought with the invasions, some fresh concepts and ideas. During the rule of the *Sakas* and their *Kshatrapas*, many enlightened kings like Kanishka brought more expansion of agriculture and land grants to the monasteries and temples. Their signs are seen from the inscriptions and excavations from Eran (Bajpai 1994) in the central part of India. The Junagarh inscription speaks about the Sudarshan Lake in Southern Gujarat in India which was constructed by Mauryan ruler *Chandragupta* (340–298 BC) and later repaired by a Saka king *Rudradaman* (130–150 AD). This lake irrigated fields until tenth century AD, but it does not exist today (Nene 2012).

The Age of the Gupta's (320–550 AD) saw the indiscriminate rise of land grants/charters to the local chieftains (Saletore 1943; Iqbal et al. 2008; Kosambi 1955; Ingalls 1976; Jha 1998; Sharma 2006). This marked the shift of the base of the economy to a decentralized rural and agrarian stage. As Mukhia (1985) indicated, the prevailing feudalism in the subcontinent flourished from the fourth or fifth century AD, as trade and urban centres declined. That process of strengthening of feudal organization of societies faced a decline in the eleventh or twelfth century when trade

and the process of urbanization once again advanced. This was the age (post-Gupta onwards) in which the Roman Empire was on the decline and its impact was also seen on the trade in the subcontinent (Sharma 2006). The grant of many more land charters to bring more land under cultivation indicates that the agricultural expansion got the highest priority at the cost of the forests. The economy of the subcontinent through this agricultural expansion became self-sustaining (James and James 2013). However, from the fall of the Mauryan empire till the age of the Guptas, the earlier practices were continued and the rulers tried to improve the existing forest policies. The ownership of forests was largely confined to the ruling kings who gave permission to the people for exploitation of forest resources (Rajarshi and Shaw 2013).

After the Guptas, the political epicentre of the subcontinent shifted from Pataliputra in eastern India to Ujjain and then Kannauj in northern India (Kumar 2009a; Sharma 2006). This age was of incessant conflicts known as tripartite struggle among the newly emerging vassals of either the Guptas or the Deccan kingdoms down South. However, this phase of political stir brought new features of interventions in the hydraulic regime with construction of reservoirs, check dams and bringing of the arcane forest areas under new rulers or victors of this struggle. For instance, the dense forests of central and eastern parts of the subcontinent were captured and local tribesmen were humbled and were slowly transformed socially by the expanding races, culturally and religiously (Biswal 2003; Sinha 1962). The constant destruction of the forests in favour of growing agriculture is the reason behind the serious loss of forest areas, for which no measures of protection were institutionalized. However, at the local customary levels conservation was practiced when forests were needed for supporting the agrarian economies. Agarwal and Yadama (1997) have analysed how community forest conservation works.

A striking feature of a different kind is seen in this period in the desert areas. A cooperative model of governance especially in the region of Rajputana, with brotherhood–clan relationship was established (Sinha 1962; Kulke 1995). The Rajputs who lived in the area transformed the semi-arid or arid region of present-day northwestern India into a hotbed of agriculture and pastoralism with concern for biodiversity. Their works were civil engineering marvels like lakes (Dhebar/Jaisamand, Udaisagar, Rajsagar) and check dams together with preservation of forests (Puri 1986; Kotraiah 1995; Barah 2003; Cox 2012). The Rajput rulers also acted as the protector of the wildlife by limiting the right to hunt in the wild (Kumar 2009b; Hughes 2015).

Quoting from the *Veda*s and *Upanishad*s, many environmentalists have declared the culture of the region as a "forest culture", imposing a deep commitment to the conservation of forests. Nevertheless, the ups and downs in concern for nature and phases of rapid deforestation are integral parts of environmental history of the subcontinent as the Vedic verses are. The continuous deforestation and expansion of agriculture in the region does not leave any doubt that the so-called *forest culture* was not a continuation and got replaced by a 'culture of deforestation', that is part of the process even today. It should be recognized that whatever forest cover exists today in the region, is the result of no 'forest culture' but the policy and rules of the colonial British administration.

### *3.1.2 Medieval Transition*

Developments in West Asia again had its effect on the medieval Indian subcontinent. The decline of the Byzantine empire and the rise of the Arabs brought the influx of invaders from the North and the Northwest in the South Asian subcontinent. The glory of that land with plenty of water, rich flora and fauna, and surplus labour made the region an attractive target for invaders (Salehi and Shekari 2013). Since the beginning of the first millennium AD, there was no unified rule of a big empire in the subcontinent and it fell prey to the Turkish Sultans (Habibullah 1961). An era of rejuvenation, socio-cultural synthesis and diffusion of new knowledge started (Habib 1969a, 1985a). The Turks brought with them not only new military technologies but also new crops and their methods of assessment of land revenue with advanced techniques of cultivation like *saquia*, *charas* and *dhenkli*, which were used to lift water from the well (Habib 1985b). Banking on these strengths many rulers like Balban, Alauddin Khilji, Muhammad Bin Tughlaq and Firoz Shah Tughlaq expanded agriculture and built new irrigational facilities (Siddiqui 2006; Habib 1964). The Turkish Sultans learned further from the local wisdom of water conservation through stepwells (*Vav* in Gujarati and *Baori* in Hindi/Rajasthani) and began to build their own versions (Chattopadhyaya 1973; Livingston 2002; Jain-Neubauer 1999). Many such stepwells are still found in the present-day Delhi area (Rosin 1993; Siddiqui and Iqtidar 1986).

While in the South the magnificence of Vijayanagara empire was visible where away from the deltas in the interiors dense forests were cleared and many irrigational projects were built, bringing vast areas under agriculture (Kotraiah 1995; Barah 2003). In contrast to the northern parts, in south Indian society the sacred institution of temples played a very important role in the local economy. There were temple towns, which had the control over vast swathes of land with administrative and quasi-judicial powers. Further, these temples domesticated many animals like elephants in their premises (Fuller 1984; Morrison 1995). Temples in peninsular India played the dual role in urbanization and agricultural expansion. This trend was similar to the innovations deployed by the rulers in the northern parts of the subcontinent (Morrison 1995). In the context of the Pandyan Kingdom, Champakalakshmi (1996) identified the impact of the western sea trade in this process of urbanization. The Tamil kingdoms in south India also experienced a similar flowering of political, economic and cultural forces at these sacred sites and nucleated settlements that were the heart of this medieval civilization. In these temple towns, priests, traders, merchants and also *ganika*s (prostitutes) were major actors responsible for the promotion of urban growth (Heitzman 1987).

The prime importance of agricultural wealth kept the politics in the northern region quite volatile. This brought the entry of the Mughals in the beginning of the sixteenth century AD. The first Mughal ruler, Zahiruddin Babur in his *Tuzuk-i-Baburi* has mentioned a variety of wild animals like the rhinos, elephants, tigers, etc. along with a rich wealth of flora and fauna in the northern region (Beveridge 1902; Gupta 1989). As the wild landscapes declined and agriculture expanded, the

rhinos seen by Babur in Peshawar got extinct from the region. This story of extinction of a species from one part of the region is not an isolated one. Similar evolutions can also be seen in the other parts of this subcontinent. For instance, Elvin (2008) in his book "The retreat of the elephants: an environmental history of China" has explained how due to various human interventions and climatic changes, the elephants roaming in the Beijing region of China went missing and they are now limited to Myanmar and the North Eastern parts of India.

The forest regime in the medieval periods can be described explicitly or implicitly as community regimes (Kant 2000). In this regime, the subsistence needs of the local people were fulfilled from the vast tracts of forests (Kant 2001). Despite so much of agricultural expansion and community dependency on forests, the forest wealth of the subcontinent was still in a reasonable state of areal coverage. The main reason was that the land and water with few technical inputs were suitable for plant growth (Habib 1985b). For instance, Babur describes about the stepwells and describes one constructed by him at Charbagh, Agra (Habib 1985b; Beveridge 1902). After Babur, Sher Shah Suri, a ruler of Afghan origin, ruled the northern parts of the subcontinent for some years. The initiatives of the Suri king were interesting and beyond his time. His compassion towards creating environment friendly features like ponds, lakes, planting trees along the highways was indicative of the concept of sustainable use of the natural environment (Rakshit and Swaqpan 2005).

The conflict over land started to emerge over the flood plains of monsoon-fed rivers as the peak flows in monsoon months started to be seen as a curse. Famines spiralled and epidemic diseases started to rise (Harrison 1994; Stone 1984; Arnold 1986). Strict methods of revenue collection co-existed with instances of the rulers giving land revenue exemption to drought and calamity hit peasants (Gupta 1989). However, this trend has shown that the institutions of the rulers had found ways to adapt to peculiarities of the hydrological regime and processes in this subcontinent, the variability associated with the monsoon that occurs over space and between seasons. The influence of post-Ghazalian Islam through the Turkish and Mughal rule provided political stability to the subcontinent from 1206 to 1707 AD but with limited scientific discoveries (Khan 1992). Although there were a few innovations brought in the age of Mughal rulers Akbar and Jehangir, but that could not match the advancement of knowledge in Europe around the same period (Khan 1992; Habib 1980, 1985a).

Expansion in the agricultural production paved way for surpluses, helped in the growth of agri-based industries and consequent surge in domestic and international trade. This became one of the reasons for urbanization and the rise of medieval towns which were just an extension of villages or a cluster of villages coming together. There were other forces also which led to urbanization like popularity of Sufism that resulted in new urban centres like Nagaur, Ajmer, Burhanpur, etc. Such a phenomenon of rapid urbanization is indeed unprecedented and it has changed human geography of the region beyond comprehension. The cities and smaller towns constructed a new hierarchy marked by certain urban characteristics, which was the major casualty of this process of urbanization (Kundu 2011). The meteoritic urbanization and a vast expanding empire of Mughals created new social entities

(like Mansabdars, Jagirdars, Zamindars, Guild Merchants, Talukdars, Patwari, Khot, Muqaddams, etc.) in action within the economy. There were now new stakeholders in the system as a middle and lower middle class to taste the power and the peasantry was bound to be stretched to its limits in the period following.

The period after the death of Mughal emperor Aurangzeb (1707) prevented any significant innovations or steps towards the conservation of nature. As this era was full with variety of crisis pertaining to *jagirdari*, continuous conflicts and battles among the regional powers like Marathas and others in the Deccan, fresh invasion from the northwest (by Nadir Shah and Ahmad Shah Abdali) and series of feeble rulers and intense intrigues at the Mughal court. A pattern of expansion in demand, commercialization and urbanization can be seen at this time which along with colonial expansion continued the rampant exploitation of socio-economic and environmental wealth of the subcontinent for many decades (Roy 2002).

### *3.1.3 Transition to the Modern Era*

The lack of strong centralized administration of the Mughals created conditions suitable for the Europeans to enter the subcontinent for trade in a big way. The Portuguese were the first to do so as they landed in Calicut as early as in 1498. In the beginning their interests were confined to trade and the religious expansion, but later they started annexing new territories. By the end of sixteenth century, the Portuguese and the Dutch got more involved in South America and Indo-China, respectively. The South Asian region then became wide open for the French and the British to expand. Due to a variety of reasons, the latter got an edge in South Asia. These ranged from winning battles (both in India and abroad), getting the royal *Farmans* (orders) and establishing dual system of governance together with a Mughal administration that was on the path of decline. One more reason for this was the age of enlightenment and scientific breakthroughs on which the strong mercantile interests was banking. The Europeans immensely benefited from the scientific knowledge that made available technologies of steam engine, railways, shipping, telegraph, botanical knowledge, etc. Finally, in the midst of chaos and anarchic situation, the East India Company emerged as a provider of stability and 'Rule of Law' in a region that fell into widespread social disorder.

The rule by the East India Company started a new era of colonial mercantilism that made the land, water and forests as the means of economic exchange (Wallerstein 1986, January 25). Slowly and steadily the colonial rulers customized the shape of agriculture as well as flora and fauna as per their requirements. Now Indian farmers were growing indigo and cotton. While large swarm of labourers were working on mining, deforestation and plantations of sugar and tea. The British also tried invading the subcontinent intellectually where the new form of anglicized knowledge became a tool for Macaulay's vision which targeted to make Indians, British in thoughts but genetically native.

The establishment of India's Reserved Forests was a big push in these times. The forest services were created to look after the exploitation and conservation of for-

ests (Rajan 1998). The forests that exist in the subcontinent today, almost without exception, were protected by law in the colonial period. On the other hand, gradually, the commercial interests of the colonial forest administration converted rich natural mixed forests to almost a monoculture of economically important varieties. They (Britishers) were world leaders in deforestation, having devastated their own resources as well as those of Ireland and other colonies (Kant 2000). Apart from this monoculture in forestry, displacement of the indigenous people was another issue. This displacement of people who herded, gathered forest products or cultivated land became the central feature of twentieth-century nature conservation in India (Rangarajan and Shahabuddin 2006). According to Mahesh Rangarajan, this displacement, which was carried out to enhance the levels of nature protection, has often been accompanied by impoverishment and dispossession of the displaced.

Similar transformation can be seen in agriculture which switched to cash crops like sugarcane, cotton, indigo, etc. (Brockway 1979; Cohn 1996). This was an era of agricultural transformation of nature in the agrarian and economic history of the subcontinent (Gadgil and Guha 1993). White (1967) described this process in the following words:

> *It was not until about four generations ago that Western Europe and North America arranged a marriage between Science and Technology, a union of theoretical and the empirical approaches to our natural environment. The emergence in widespread practice of the Baconian creed that scientific knowledge means technological power over nature can scarcely be dated before about 1850. Its acceptance as a normal pattern of action may mark the greatest event in human history since the invention of agriculture, and perhaps in nonhuman terrestrial history as well.*

Ribbentrop (1900) has earmarked the phase between 1796 and 1850 in different stages before the evolution of a structured and coherent British Forest Policy . Within a few decades of gaining the colony in South Asia, the British mastered the art of ruling the subcontinent and came up with a variety of enthralling colonial legislative instruments (Sivaramakrishnan 1995) that restricted the customary rights of the local people. The colonial legislative instruments like the Forest Act of 1878, which later served as a model for other British colonies had very serious consequences. With one stroke of the executive pen attempted to obliterate centuries of customary use of the forest by rural populations all over India (Guha and Gadgil 1989). Soon the local folks of the forests and the sons of the soil were uprooted from their land. A few of them were employed as forest guards. Apart from capture of the resources of the tribals they were criminalized for their lifestyles. For instance, *Yanadis*, who were "very partial to sour and fermented rice-water", were stopped by the Forest officers from drinking it, as it made them lazy (Tolen 1991). This had a negative effect on the native inhabitants and there emerged a series of protests, often violent forest movements of the forest-dwelling communities (Sarkar 1982, 2014). Such movements were meant for their access to natural resources of "*Jal, Jangal aur Zameen*" (Water, Forest and Land) (Xalxo 2007). However, as presented by Tian et al. (2014), the inevitable environmental change in India has been the changes in land use and cover from forests to cultivation, a trend that still continues.

The Indian National Congress took certain initiatives and brought numerous resolutions stressing on the suffering of the people caused by the forest administra-

tion. Resolutions condemning forest laws were passed every year between 1891 and 1895. However, the response was not very strong as the Congress also avoided such environmental issues by terming the conflicts as local (Sarkar 1982, 2014). Later in the Gandhian phase of freedom movement the battle entered the legal and legislative phase. This resulted in the emergence of environmental jurisprudence, starting a phase that made the natural environment a legal object in the British era. Here one can see the process of making of law, process of litigation, the formation of jurisprudence and the relationship that developed between the legislature and the political institution in the country at large (Sivaramakrishnan 1995).

The forces of colonial scientific knowledge from the west were often used in the subcontinent out of context or only as prudent for short-term gains. For instance, Dutt (1950) quoted the evidence given by Wallick (Superintendent of the Botanical Garden near Calcutta of the East India Company to the Commons' Committee as follows:

> *The husbandry of Bengal has in a great measure been misunderstood by the Europeans…….. very sudden innovations in them have never led to any good results…….for instance, when European iron ploughs got introduced into Bengal…….the soil being extremely superficial, which was intended to be torn up, has generally received the admixture of the under soil, which has deteriorated it very much.*

The role of religious and ethnic values in preserving the traditional community reserves and commons like the ancient sacred groves and rivers is important. Gadgil (1991) mentions in this connection the practice of village communities of preserving the biodiversity and unique ecosystems, such as the Myristica swamps of the Western Ghats. However, with social transformations and growth in population, the followings of such institutions have declined as has been shown by Singh (1995) on the landscape and sacred topography of the pilgrimage temple town Varanasi and its effect on the water quality of the river Ganga (Singh 1995). In the twentieth century, the British policy expanded the base for industrial production in South Asia, mainly for strategic reasons. Thus, in addition to drastic changes in land cover, the environmental changes now included industrial pollution of air and water. As the struggle for ending the colonial rule in the subcontinent progressed, popular aspirations for industrial growth and higher levels of individual consumption, nevertheless, did not deviate from the traditions created by colonialism.

In India, forest regimes have completed a full cycle, starting with the community regime in the pre-British period through state regimes during the colonial period, and finally an attempt back to community-based forest regimes in the 1990s (Kant 2001). During the colonial era in India, the changes in forest regimes were discontinuous, but path dependent in the geographical sense. In the first phase of independent India, many self-reinforcing mechanisms (such as increasing returns, organizational and institutional inertia, and adaptive expectations) contributed to temporal path dependence. However, environmental sustainability took a back seat as the British colonial rule ended in 1947. Even the so-called conservationists' attempts took new avatar in the name of protectionism with an exclusionary conservationist approach and elite environmentalism (Saberwal and Rangarajan 2005). The aspirations of the people in general, and the ruling class in particular, followed the traditional path of economic growth, not informed by the long-term environmental

losses. This sowed a seed for a very serious consequence, which India is still paying in its post-independence times. It was the discontinuity in the mutual symbiotic relationship between the humans and their environment. The forests, animals and the forces of nature which were worshipped since the ages were now an object of economic extraction, albeit in the short run.

## 3.2 Social Innovation in the Post-Colonial Period: Struggle for Forest Rights in the Himalayan Region

### *3.2.1 The Indian Himalayan Region and Uttarakhand*

In the background of the above historical account, it can be seen that the natural environment of the subcontinent underwent rapid transition in the past century. Negative environmental impacts of economic activities enhanced environmental consciousness, and gave birth to environmental movements, based on a great variety of issues of environmental destruction and threats to lives. Probably the most known of these movements is the forest rights movement called *Chipko* (tree hugging) that emerged in the Uttarakhand area of the Indian Himalayan Region (IHR). The Himalayan arc of about 3000 km in length includes quite a large part of the border between China or Nepal or Bhutan and India. From a small village in the large mountain area of the Indian Himalaya emerged a social innovation for establishing forest rights of the local people and limits to forest exploitation. This innovation later became known as a globally celebrated forest rights movement.

During the later part of the decade of 1960s, mainly as a result of the armed conflict in 1962 between China and India emerging from disputes over border in the inaccessible Himalayan areas, rapid expansion of the network of roads in the interior areas of the Indian Himalayan Region (IHR) had been taken up in India as a national priority. The mountain communities in the inaccessible parts of the IHR largely practiced subsistence farming, in which tree fodder constituted vital provisioning services from the local forests. In addition, the forests provide vital sources of energy for cooking and space heating, in the form of fuel wood. The growing network of roads greatly improved the accessibility of these mountain areas. It strengthened the commercial links between the subsistence economies of the mountain villages and the market in the adjoining plains. In this way the natural resources of the interior Himalayan areas, especially forest resources and minerals, started to be extracted from ever larger areas and exported to the plains. In turn, the imports from the plains, especially food grains and consumer items, also increased rapidly. The enhanced availability of food grains and consumer items created new aspirations based on a need for higher cash flows in the mountain communities that traditionally practiced barter trade. While this dynamic transition was applicable for all the areas of the IHR, this section describes the social innovation that created a popular movement for forest rights of village communities in the area presently known as the State of Uttarakhand in the IHR (Fig. 3.1).

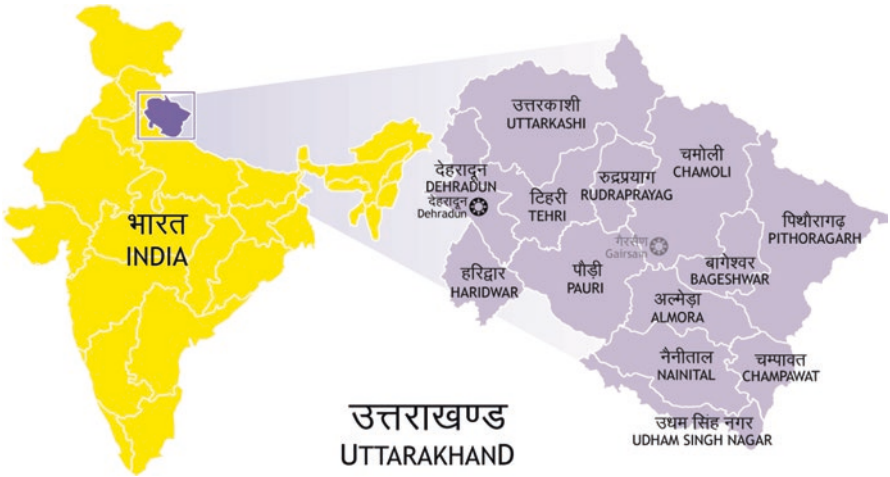


**Fig. 3.1** Location of Uttarakhand in India (http://www.bing.com/images/search?q=Uttarakhand+India+Map&view=detailv2&&id=BA8C161BB6ED300AD6129F22777FA19152372951&selectedIndex=0&ccid=rzUelh85&simid=608027955303481479&thid=OIP.Maf351e961f39a39a3dcae510359a1753H0&ajaxhist=0)

### *3.2.2 People-Forest Linkages in Uttarakhand*

Due to the orographic and climatic conditions in the Himalaya, the region had most of the land area (about 70 %) under forest cover or bare rocks and small areas (about 10 %) as farmlands, on which mountain communities practiced traditional subsistence farming. Use of timber from the forests was limited to making houses or agricultural tools. Green felling for commercial timber extraction was not part of this traditional framework.

Commercial extraction of the forests in Uttarakhand (Fig. 3.1) started when the British arrived as the rulers after their victory in 1815 in the war against the Gorkha kingdom of Nepal. The British started commercial forestry with the exclusive authority lying with the official Forest Departments and contractors selected by the Department. In this new management strategy, forest areas were reserved for large-scale commercial extraction with restricted access of the communities. The communities had no role in the commercial extraction of the forests, except as labourers, though most villages were near to the reserved forests. In the Tehri-Garhwal region, which was not under direct British rule, the impact of the forestry practices of the British was carried by a British timber merchant, Wilson. He entered into forest felling contract with the King of the princely state of Tehri Garhwal and made huge profits. Moench and Bandyopadhyay (1986) have given a systematic description of the linkages between the people and forests in the Tehri Garhwal region.

The commercial objectives and monopolistic functioning of the Forest Departments in India did not change much even when the colonial rule ended in 1947. Green felling and extraction of Pine sap continued to be undertaken in the

Chir Pine dominated forests of mid-hills of Uttarakhand. This was taken up by contractors who obtained permits from the State Forest Department through auctions conducted by that Department. These contractors were rich people and usually came from cities like Dehradun, Lucknow and Delhi, far away from the mountain villages. They prospered from the sale of timber and Pine sap, a process from which the local villagers did not benefit at all. The forest contractors were the de facto rulers of the remote mountain areas. The villagers had always seen this as an unjust transfer of wealth from the local forests around their villages by rich contractors coming from distant cities. With little scope for local employment, many in the IHR migrated seasonally or permanently to the cities in the plains in search of jobs. Such migration left the women and children back in the villages, which caused social problems and instability in the families.

### *3.2.3 Political and Economic Activism in Uttarakhand*

During India's struggle against British colonial rule, the Uttarakhand region was active and a very good network of social activists of diverse political leanings was created. After India became independent, these activists devoted their organizational efforts towards social and economic uplift of the village communities. The network of Gandhian social activists in Uttarakhand functioned under the umbrella organization called *Uttarakhand Sarvodaya Mandal*. They took up organizing the people against widespread alcoholism among men, for social empowerment of women and protection of the forests.

Working on the idea of promoting local employment through small rural industries, based on local natural resources, the *Uttarakhand Sarvodaya Mandal* established a number of small industries to use local timber, medicinal herbs, Pine sap, etc. These small industries produced agricultural implements, furniture, resin, medicines, etc. Such rural industries were named *Gram Swarajya Sanghs* or autonomous village unions. The Forest Department gave these organizations permit for limited green felling and tapping of Pine sap. These small rural industries became a big inspiration for local people as possible creator of gainful employment opportunities within the mountain villages themselves.

In July 1970, landslide and floods took place in the upstream areas of the Alaknanda river flowing through the Garhwal region. Such large-scale mass-wasting events are not unexpected in the Himalaya, especially in the monsoon months. The widespread land slides and floods in the Alaknanda watershed, however, generated a public opinion that these events were caused by deforestation in the region that was accelerated by commercial felling by the contractors who were given felling permits by the Forest Department. Thus, a feeling of stewardship of the local forests for ensuring environmental stability in the region germinated in the minds of the local people as a perceived precautionary measure. Slowly but steadily, the environmental damages from landslides and floods became a strong public justification

for the social demand for ending the role of external contractors in commercial extraction of the forests in favour of the small-scale extraction by the small industries in the villages. It is at this stage that the latent conflict of interests between the local village organizations and the forest contractors from distant cities started to be voiced openly. In the period 1970–1973 villagers perceived as related the commercial felling of trees by external contractors and the threat to their lives from the massive landslides and floods in the region, strengthening the popular demand for stopping the external contractor system. Obstruction to the contractors was made in 1973 in Mandal. Mishra and Tripathi (1978) have given a detailed account of this accumulation of public grievances against the practice of forest felling by the contractors.

### *3.2.4 Social Innovation for Forest Rights*

On 26 March 1974, one of many such latent popular disapproval expressed itself as an open non-violent action of resistance to tree felling by external contractors by the people in village Reni located in the Alaknanda watershed. The nearby *Dasholi Gram Swarajya Sangh* was first given allocation of 12 Ash trees in the forest near the village Reni, for making agricultural implements. The allocation was unilaterally withdrawn by the Forest Department who cited environmental conservation as the reason (Joshi 1982). At the same time, a sports good manufacturer from the far away city of Allahabad was allocated 32 Ash trees from the same forest area. There was serious popular opposition to this decision. On that day the men of the village Reni had gone to the Forest Department office some distance away, to discuss the dispute over allocation of trees for felling. At the same time the contractor of the sports goods company from Allahabad sent tree loggers to the forests near Reni to fell the trees already marked. At this time as the men of Reni village were away taking part in a meeting at the forest office only women were present in the village. The elderly lady of the village, Gaura Devi, quickly assembled a group of 29 women and decided to oppose the felling by entering the forest and reaching the site where stood the trees marked for felling. They marched to the spot in the forest with determination and in a non-violent manner. This was the beginning of an innovative non-violent intervention of the villagers who saw small scale commercial extraction of the local forests by local people as an option for sustaining the local environment and livelihoods at the village level. Considering the traditional political influence of the forest contractors in the remote villages, this marching of village women from Reni to the forest area and their determination to resist felling by the contractor's axemen was an innovation in courage. It made the loggers from distant cities unsure of whether to accept a confrontation or retreat. After a lot of verbal exchanges the axemen decided to avoid confrontation and moved out of the forest. The women of Reni, till then, did not quite perceive that in addition to creating a finale of the emerging conflicts over forest felling in Uttarakhand, they had just laid the innovative foundation of a movement for sustainable extraction of the Himalayan forests,

that later became globally celebrated in the years to follow as the *Chipko* movement (Bandyopadhyay 2004; Joshi 1982).

The news of the success of this innovative idea of village women of Reni in resisting felling by the contractors' men quickly spread all over Uttarakhand. Very soon this innovation got replicated in other areas by both men and women. The latter constituted the main force of the resistance as many male members of the village had moved to distant cities for employment. Thus was born the people's movement in Uttarakhand against non-local forest contractors. It demanded greater role of the village organizations in commercial extraction of local forests and soon became known by the name *Chipko* which literally means 'Hugging' the trees. The local protesters told the contractors that they would hold on to the trees to prevent them from felling by the external contractors. The spirit of the movement is expressed through a compelling couplet in the local *Garhwali* language written during the movement by the folk poet and activist Ghanshyam Sailani:

*Chipka dalion par janglu bachonda*
*Paharon ka sampatti ab na loothenda*

meaning: Hug the trees to protect forests from felling
Stop the loot of the property of the mountains

The innovative action by the women of Reni village by marching in large numbers to the forest area led to the creation of a non-violent people's movement in Uttarakhand, which forced a change in governmental policy on the extraction of forests in the mountainous parts of the state. The *Chipko* movement wanted a greater role of the village communities in the extraction and conservation of local forests of Uttarakhand. The movement ignited popular aspirations for livelihoods based on small-scale extraction of the forests. The government of the State of Uttar Pradesh, to which the area of the present State of Uttarakhand then belonged to, in 1975 agreed to bring to an end the contract system of felling of the Himalayan forests. There was also a greater role of the village communities in the process of forest felling. Over the years, this movement inspired environmental groups in India as well as many other countries. The idea that non-violent resistance in the form of hugging trees to be cut down constituted the other part of the social innovation. While the movement got its name from the popular commitment to hug trees if needed, to protect them from felling by the axe men of the forest contractors, the recorded history of the movement over the last 41 years brings out that hugging was resorted to only once on 8 January 1978. Courageous Gandhian social activist Dhoom Singh Negi accompanied by friend Hukam Singh Negi, both of Pipleth village stopped felling by resorting to hugging trees at Salet forest in Tehri Garhwal. *Chipko* movement grew out of the popular resistance against the monopoly on commercial extraction of the forests enjoyed by rich contractors from distant cities and in favour of a greater role of the village communities in commercial green felling, extraction of Pine saps, etc. In other instances of resistance, the presence of large number of agitated and slogan shouting villagers in the forest areas was enough to discourage the contractors.

The movement has been the subject of hundreds of books and articles as well as many doctoral dissertations. However, many of these publications have probably

been based on subjective accounts and, thus, created significant distortions in the public image of the movement. It was Guha 1990 who drew the important distinction between the local reality of *Chipko* as a 'quentessential peasants' movement' of village communities over access to forest products and its global image as a celebrated environmental conservation movement.

#### 3.2.4.1 Judicial Innovation for Sustainable Environment

The issue of environmental sustainability has been a matter of sincere interest to the Indian Judiciary, in particular the Supreme Court of India. Over the last three decades, the Court has taken great interest in introducing a number of innovative measures in resolving environmental conflicts and litigations. These pioneering innovations by the Indian judiciary have also been emulated in many other countries. Some of these innovative measures include: taking suo moto action against polluters; entertaining petitions on behalf of parties and inanimate objects (such as nature and wildlife, which cannot file litigation themselves) affected by environmental damages like pollution; expanding the sphere of litigation; and introducing environmental principles such as the principle of 'polluters pay', the precautionary principle, absolute liability and the public trust doctrine, etc. These measures were mainly aimed at environmental safety and protection in a general framework for advancing the well-being of the people.

Undoubtedly, the most important of such judicial innovations was the introduction of the process of Public Interest Litigation (PIL). Until the early 1970s, litigation in India was in its rudimentary stage because it was seen as a pursuit for the vindication of private vested interests. During this phase, the initiation and pursuance of litigation rested entirely with the aggrieved individual. The traditional rule in regard to *locus standi* is that judicial redress is available only to a person who has suffered a legal injury by reason of violation of his legal right or legal protected interest by the impugned action of the State or a public authority or any other person or who is likely to suffer a legal injury by reason of threatened violation of his legal right or legally protected interest by any such action. It was in the case of Maharaj Singh v. State of Uttar Pradesh & Others (AIR 1976 SC 2602), Justice V R Krishna Iyer observed that "Where a wrong against community interest is done, 'no *locus standi*' will not always be a plea to non-suit an interested public body chasing the wrongdoer in court". Similarly, in the case of S.P. Gupta v. President Of India And Others (AIR 1982 SC 149) the Court under the leadership of Justice P N Bhagwati observed that

> *where a legal wrong or a legal injury is caused to a person or to a determinate class of persons by reason of violation of any constitutional or legal right or any burden is imposed in contravention of any constitutional or legal provision or without authority of law or any such legal wrong or legal injury or illegal burden is threatened and such person or determinate class of persons is by reason of poverty, helplessness or disability or socially or economically disadvantaged position, unable to approach the Court for relief, any member of the public can maintain an application for an appropriate direction, order or writ in the*

*High Court under Article 226 and in case of breach of any fundamental right of such person or determinate class of persons, in this Court under Article 32 seeking judicial redress for the legal wrong or injury caused to such person or determinate class of persons*

A complete change in the Indian jurisprudence scenario was observed in the 1970s, with the efforts made by Justice P N Bhagwati and Justice V R Krishna Iyer. The introduction of the system of PIL is the judicial innovation that has emerged as a very important tool, especially for the poor in seeking justice. In many subsequent cases, the Supreme Court described the concept of PIL as an important instrument to bring justice to the doorsteps of poor and weaker sections of the society.

The Court started to entertain PIL for environmental protection in early 1980s and over the last three decades PIL has been an important instrument for environmental groups to protect the rights of the inanimate objects and rights of people affected by environmental insecurity in many significant ways. First, prior to the emergence of the concept of PIL, Criminal Law provisions as contained in the Indian Penal Code, Civil Law remedies under the law of Torts and provisions of the Criminal Procedure Code were the main legal tools for providing remedies in respect of public nuisance cases, including air, water and noise pollution. Due to the general lack of people's awareness about environmental laws, there were problems in drawing the attention of the Court to bring relief from environmental damages. Moreover, there was no provision in the environmental legal framework for allowing the third party to seek the intervention of the Court, if the party concerned was not directly affected by environmental problems (Curmally 2002). Hence, the biggest hurdle in the path of litigation for seeking environmental justice was the traditional concept of *locus standi*. Earlier, when a petitioner approached the appellate Court for seeking relief in respect of an injury he did not suffer directly, the case was not maintainable, as the appellate Court would invariably focus with the status of the petitioner rather than the subject of petition. However, now the judicial approach has changed in that any member of the public having a genuine interest may be allowed to initiate the legal process with a view to asserting diffused and meta-individual rights. Generally, in the context of environmental litigation, the parties affected are a large, diffused and unidentified group of people. Therefore, the question is who ought to bring such cases to the Court's notice wherein no personal injury, in particular, has been noticed. In such situations, the Court has emphasized that any member of the public having a sufficient interest may be allowed to initiate the legal process in order to assert diffused and meta-individual rights related to environmental problems.[1]

A number of cases related to environmental issues initiated through PIL have been brought to the Court's attention beginning with the limestone quarrying case[2] in Doon Valley in Uttarakhand in 1983 (Bandyopadhyay 1989). This trendsetting litigation resulted in the relief to the rural population in the valley and residents of the city of Dehradun from impacts of open cast limestone quarrying in the hilly parts of the

[1] RLEK v. State of Uttar Pradesh and Others, Supreme Court of India, AIR 1985 SC 652.

[2] The Dehradun lime stone quarries litigation filed by the Rural Litigation and Entitlement Kendra in 1983 was the first PIL case filed in the Supreme Court related to environmental issue in the country.

Valley. It also opened up the path for drawing the attention of the judiciary to almost all major issues of environmental degradation in the country. The Doon Valley case was followed by the Ganga Water Pollution case, Delhi Vehicular Pollution case, Oleum Gas Leak case, environmental risks of the Tehri high dam case, Sardar Sarovar Dam case, coastal management case, industrial pollution in Patencheru, T.N. Godavarman case, among many others. These cases had been initiated by non-governmental organizations (NGOs) and environmental activists on behalf of other individuals and groups or the public at large with a view to seeking the implementation of statutory acts and constitutional provisions aimed at the protection of the environment from human induced damages and enforcement of fundamental rights. It has been found from the Supreme Court Case Reports that out of 221 environmental cases brought before the Court from 1980 to 2010, 84 had been filed by individuals not directly affected by any of the above-mentioned cases, while 39 by Organizations on behalf of the affected parties. This suggests that the innovation of the instrument of PIL as an effective legal option has provided an immense opportunity to the third party to represent the affected people and the natural environment itself.

The Court also has gone a step ahead in expanding the sphere of its orders and directions to protect and improve the environment. For example, in the case of MC Mehta v. Union of India and Others (AIR 1988 SC 1037), Mehta filed a petition before this Court complaining that neither the Government nor the people were giving adequate attention to stop the pollution of river Ganga, India's most important and revered river. It was, therefore, necessary to take steps for the purpose of protecting the cleanliness of the river Ganga and sought the issue of a writ/order/direction in the nature of mandamus to the respondents restraining them from letting out the trade effluents into the river Ganga till such time they put necessary treatment plants for treating the trade effluents in order to arrest the pollution. The Court, however, directed issue of notice under order 1 Rule 8 of the Code of Civil Procedure treating the case as a representative action by publishing the gist of the petition in the newspapers in circulation in northern India and calling upon industrialists and the municipal corporations and town municipal councils having jurisdiction over the areas through which the river Ganga flows, to appear before the Court to show cause as to why direction should not be issued as prayed for by the petitioner asking them not to allow trade effluents and sewage into the river Ganga without appropriately treating them before discharging. In this case, the petition was filed against the Kanpur tanneries and Kanpur Municipal Council to stop polluting the river Ganga. But the Court had asked all the industrialists and the Municipal Corporations and the town Municipal Councils with areas coming under their jurisdiction to appear before the Court. Similarly, in 1995, TN Godavarman Thirumulpad filed a writ petition in the Supreme Court of India for protecting the Nilgiris forest land from deforestation through illegal timber operations.[3] The Court while hearing the Godavarman case extended its scope, i.e. preventing illegal operations in one forest to include the reformation of the country's general forest policy.

[3] T. N. Godavarman v. Union of India, Supreme Court of India, Judgment of 12 December 1996, AIR 1997 SC 1228.

The positive impact of the Court's approach to environmental litigations through third-party representation has dramatically transformed the form and substance of environmental jurisprudence in India. Taking recourse to judicial intervention for justice can prove to be a costly exercise for those who have already experienced substantial losses from environmental damages. Even if the aggrieved party takes recourse to judicial intervention, the Court might only settle the disputes between the appellant party and the parties responsible for environmental damages, while there is every possibility of the rights of other aggrieved persons remaining unsettled. Judicial remedies for environmental maladies could lead to effective results if the remedies benefit also those who are not a party to the litigation process. By entertaining petitions filed on behalf of the poor and the disadvantaged sections of the society, the Court has attempted to uphold the rights of people in terms of deciding compensation and providing other remedies to the affected people. Allowing a third party to bring environmental problems to the Court's notice has also an important bearing on inanimate objects, which cannot represent themselves in the litigation process. Hence, it is important that the state of the inanimate objects is represented by NGOs and environmental activists through the instrument of PIL. Thus, the rationale underlying PIL is that it is the responsibility of the polluter to pay a price for the damage he has done to the natural objects and thereby restore the environment to its natural state.[4]

More recently, the Supreme Court of India has taken another innovative step, by establishing the National Green Tribunal (NGT) in 2010 under the National Green Tribunal Act 2010. This was done for effective and expeditious disposal of cases related to environment. The NGT is expected to dispose of the cases within a period of six months. While the judiciary ensures the rule of law, the law can be reviewed, changed or replaced by the Parliament. In this regard, another form of prospective innovation may be in the offing in India. The appointment of the High Level Committee (HLC) to review the various Environmental Acts is another innovation that has caught the public attention. The HLC submitted its Report in November 2014. Commenting on the Report of the HLC, Iyer (2015) observed that "the HLC has produced a hasty, half-baked, inadequately thought-through report. If accepted by the government and implemented, it will have serious adverse consequences. The report needs to be totally rejected." Many critics see this outcome favourably, as a step counter to the earlier innovations that may go against environmental sustainability. Many see it as an attempt of the governmental growth fundamentalism to undo what the PILs have been working for. This brings us to the end of recent most innovation in environmental sustainability in India. It also concludes a long history of ups and downs in social innovations related to environmental sustainability in India over a period of about 5000 years.

**Acknowledgement** The author wishes to thank Mr. Deepak Singh and Prof. Geetanjoy Sahu for their significant help in drafting parts of this chapter.

[4] Indian Council for Enviro-Legal Action v. Union of India (Bichhri village industrial pollution case), Supreme Court of India, Judgment of 13 February 1996, 1996 (3) SCC 212.

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# Chapter 4
# Restoration of Ecological Status of Himalayan Rivers in China and India: The Case of the Two Mother Rivers—The Yellow and the Ganges

**Jayanta Bandyopadhyay**

**Abstract** This chapter first introduces the contribution of the Himalayas as the Water Tower of Asia, especially for the large countries of China and India. For the role of the Himalayan rivers of the Yellow and the Ganges, in giving birth and sustaining human civilizations in these countries, they are revered as the respective "Mother Rivers." With rapid growth in the population in the two most populated countries with very rapidly growing economies, these two rivers have been impacted badly in terms of quality and quantity of their flows. Governmental and nongovernmental concerns over the decline of the ecological status of all rivers in China and India have led to important social innovations. The chapter reviews the research and innovations in policy and institutions made in China and India for ecological restoration of their rivers. In this context, the chapter reviews the status of clarification and articulation of environmental flows in the rivers in general but in the Yellow and the Ganges rivers in particular.

**Keywords** Economic growth • Environmental flows • Ganges • Himalayan rivers • Yellow River

## 4.1 Introduction

The Rio Earth Summit in 1992 stressed on the crucial role of the mountains of the world in the provisioning of very large volumes of freshwater used by the human societies and the regulating services of moderating and delaying surface runoff by functioning as temporary storage for this vital product of nature. This great

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S. Dong et al. (eds.), *Environmental Sustainability from the Himalayas to the Oceans*, DOI 10.1007/978-3-319-44037-8_4

contribution of the mountains led to their being described as the 'water towers' of the world (Bandyopadhyay 1996). The Himalayan region contains the highest mountains of the world that acts as great barriers to the global atmospheric circulations, especially the Indian summer Monsoon (ISM) and the East Asian Summer Monsoon (EASM). The interaction of the mountain and the monsoon brings much of the annual precipitation over Asia during the months of May to September. Accordingly, the Himalaya is increasingly getting described as the 'water tower of Asia.' The water security of China and India is not only a matter of great importance in Asia, due to the fact that more than a third of the global population live in these two countries, water futures of these countries assume global significance. As China and India aspire for food security and high rates of economic growth in the coming decades, the Himalaya is being looked up to with high expectations of greater water supplies. A brief review of how the innovations in the two countries are addressing the challenges in both science and policy in sustaining or restoring the ecological status of the Himalayan rivers, in general, and the Yellow River and the Ganges, in particular, will be presented in this chapter. These rivers are also known as Huang He and Ganga in China and India. The transformations in policy are the result of sustained people's movements, scientific debates, and innovations.

The Himalayan region encompassing the Hindu-Kush mountains and the Qinghai–Tibet region of China, spanning an area of more than 4.3 million square kilometers, is the origin of ten major and hundreds of minor rivers of Asia. These rivers originating in the Himalayan region are identified here as the Himalayan rivers. They include the Yellow River and Yangtze, emerging from the Qinghai–Tibet Plateau providing water to the densely populated parts of north-China plains; Mekong, Salween, and Irawaddi, flowing southwards from Tibet into S-E Asia; the Ganges and Brahmaputra-draining large areas in both the north and south aspects of the Himalaya providing about two-thirds of the total annual river flows for India; and the Indus, the lifeline of Pakistan. Further north, the Amu Darya and Tarim supply water to very dry areas in Central Asia and Xinjiang region of China (Figs. 4.1 and 4.2).

The region is spread over Afghanistan, Bangladesh, Bhutan, China, India, Myanmar, Nepal, and Pakistan as shown in Figs. 4.1 and 4.2. The region stores more snow and ice than anywhere else in the world, outside the two poles. Hence it is also getting a popular name as 'The Third Pole'. The rainfall is especially heavy along the southern foothills of the Himalaya, spanning from Myanmar to the Indian state of Uttarakhand, the eastern edge of the Qinghai–Tibet Plateau and the eastern plains of South China. While the largest share of the terrestrial area of the Himalaya lies within the boundary of China, the largest share of water flowing in the Himalayan rivers passes through India, and further downstream, through Bangladesh.

The waters of the Himalayan rivers have supported several great civilizations of Asia, like in the basins of Yellow River, Indus, Ganges, Mekong, etc. As a mark of recognition to such crucial support, the Yellow River in China and the Ganges in India are identified as 'Mother Rivers' of the respective civilizations. Without the existence of the Himalaya as water tower, and the rivers draining it, these civilizations would not have flourished the way they have, and human history in Asia would have been very different.

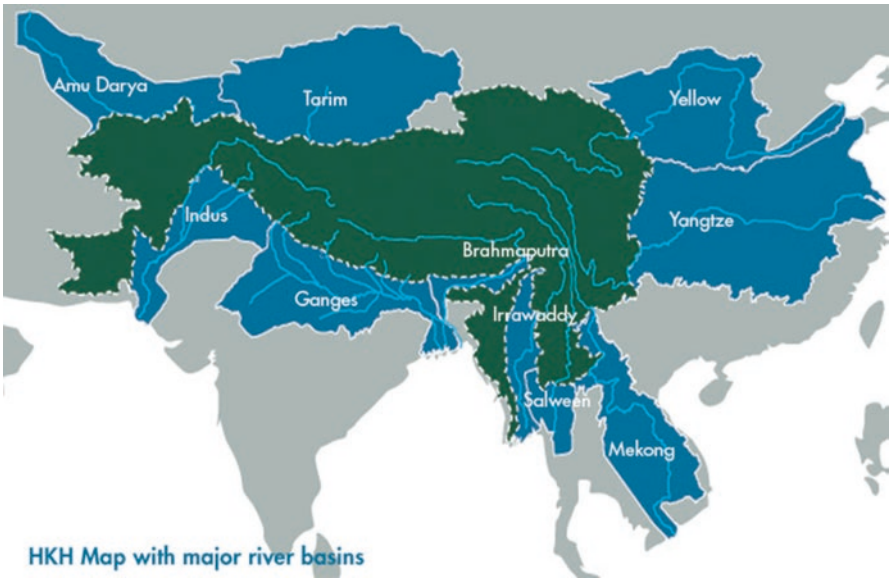


**Fig. 4.1** Range of Hindu Kush Himalayas region (*source*: ICIMOD)


**Fig. 4.2** The basins of the Himalayan rivers (*source*: ICIMOD)

The Himalayan river basins are the home of about 1.3 billion people (Lamadrid and Mac Clune 2010) and more than three billion people benefit from the water supplies as well as the food and energy produced in these river basins. The rivers carry not only water but also great amounts of sediment. In the upper reaches, they embody very large quantities of energy, both potential and kinetic. In the ecohydrology of the Himalayan rivers, these three constituents of flow are central distinguishing features. Human interventions in the Himalayan rivers that would be ecologically stable, need to be based on adequate knowledge of all these three constituents of the flow.

The Himalayan rivers have large basins that are also characterized by complex ecosystemic processes, involving water, sediments, and energy. These processes link the various parts of their basins, from the Himalaya to the various Seas they finally merge with. The Himalaya is a young unconsolidated mountain system prone to regular seismic activities which make the landmass fragile and unstable. In addition, the South aspect of the main crest line and the eastern edge of the Qinghai–Tibet Plateau receive the intense precipitation from the ISM and the EASM. Accordingly, in addition to providing large supplies of water, the Himalayan rivers are very heavily loaded with sediments and in the mountainous parts of their journey, embody large potential energy. This makes the Hunag He the most silt-laden river in the world with average silt concentration of 35 kg/m$^3$ (Fu and Chen 2006). On the other hand, the Ganges–Brahmaputra carry the largest total annual sediment load of 2179 million tons (Curray and Moore 1971). The combination of availability of ample water from a monsoon-dominated climate and high sediment load of the Himalayan rivers facilitated flourishing agriculture. However, at the same time, these rivers often cause destructive floods.

The large drop and steep slope of the river beds have made all Himalayan rivers objects of extensive hydropower development in both China and India. The Himalayan rivers are looked up as sources of large volumes of water, but ecological challenges in the wise use of the Himalayan rivers have not yet been adequately understood and addressed (Bandyopadhyay 2013). Over the second half of the last century, waters of the Himalayan rivers in China and India have been utilized extensively by diversion of flows and the rivers are severely polluted by dumping of untreated urban and industrial wastes (Gleick 2009; Murty and Kumar 2011). The result has been widespread ecological degradation, from drying up of downstream parts as well as stoppage of the functioning of the riverine ecosystems. In this situation, the two countries will have to feed about 700 million more people by 2050. Further, the two countries have high rates of economic growth and urbanization. This will drastically increase the pressure on available amounts of water for meeting the growing demands from water-intensive foods (Amarasinghe et al. 2008: 23). The allocation of water for in-stream uses and diversions is at the core of this new water management challenge. Restoration of good ecological status of these rivers has been declared as national objectives in both countries. In the 12th Five Year Plan (2011–15) document of China establishment of an 'ecological civilization' in that country has been accepted as a national objective (http://cbi.typepad.com/china_direct/2011/05/chinas-twelfth-five-new-plan-the-full-english-version.html). Similarly, the National River Conservation Directorate in India has taken up the task of cleaning the rivers in India together with the Ministry of Water Resources (http://www.moef.nic.in/sites/default/files/NRCD/More.html). The prob-

lem of pollution is more an issue of institutional malfunctioning and less of any gap in river science. That may be rectified with better functioning of the regulatory institutions. However, the issue of quantitative allocation among contending water demands needs deeper ecological knowledge of the whole river systems all along the basin, starting from the Himalaya and ending at the coastal zone around their confluences of the rivers with the seas.

This chapter is to review the emerging policy environment for facilitating the ecological restoration in both countries, of the Yellow River and the Ganges, and also to assess the availability of necessary scientific knowledge for achieving the declared goals. The recognition and allocation of water flows for the restoration of good ecological status has emerged as a major challenge for science and policy in China and India. One prerequisite for addressing this is a clarity of the concept and application of 'environmental flows.' Within the limited scope of this chapter, the nature of articulation of the variety of concepts about 'environmental flows' and the status of its use in the management of Himalayan rivers in the two countries would be taken as an indicator of how the task of ecological restoration is emerging in the respective countries. The question of allocation of water for sustaining the ecological status of rivers is faced by China and India in the middle of their respective drives to industrialization. This was not the case for Europe during the rapid environmental changes resulted by the industrial revolution. Thus, China and India have the choice of taking innovative approaches for sustaining and restoring the ecological status of their rivers. For this, the approach to ecological restoration of the two most important rivers in the two countries, the respective Mother Rivers, the Yellow and the Ganges, will be briefly reviewed in this chapter.

As a background to the present challenges, and the importance of the Himalayan rivers in China and India, a short historical account of the contribution of these two Himalayan rivers to the growth of human civilizations in these two countries will be briefly reviewed. For their diverse uses of the river waters, these civilizations have been described as 'hydraulic civilizations' (Wittfogel 1957). The population projections (Fig. 4.3) and distribution of population densities (Fig. 4.4) indicate how the populations in China are concentrated in the Yellow River and Yangtze basins and that of India in the Ganges–Brahmaputra basin. The corresponding challenges related to water availability is obvious from Fig. 4.5 that shows the water stress in the Yellow River basin and the periodic problem of floods and water scarcity in the Ganges basin.

## 4.2 The Contribution of Himalayan Rivers to the History of China and India

### *4.2.1 The Himalayan Rivers in the History of China*

The birth and growth of the Chinese civilization and the water of the Himalayan rivers Yellow River and Yangtze are almost synonymous. The Yellow River originates from the northwestern Qinghai province of China in the Himalaya and flowing

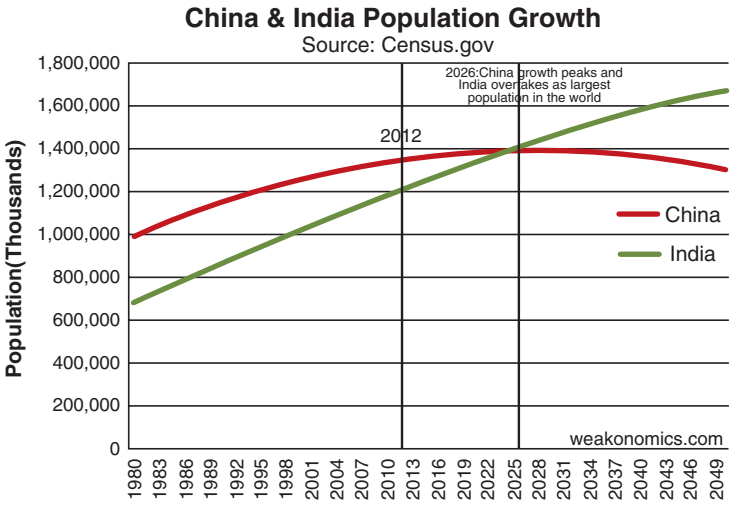


**Fig. 4.3** Estimated population scenario of China and India till 2050

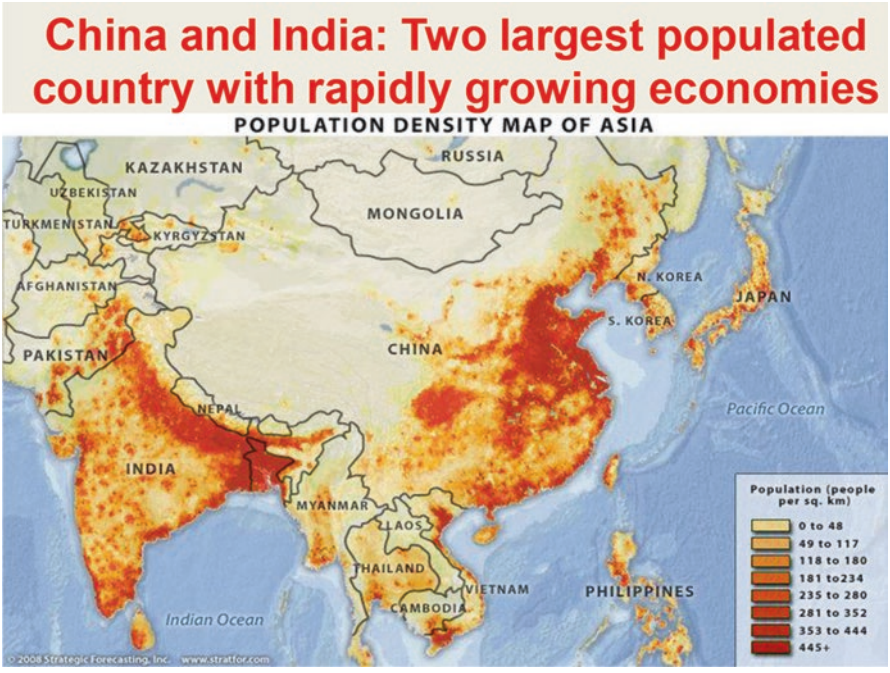


**Fig. 4.4** Distribution of population in China and India (*source*: http://www.china-mike.com/china-travel-tips/tourist-maps/china-population-maps/)

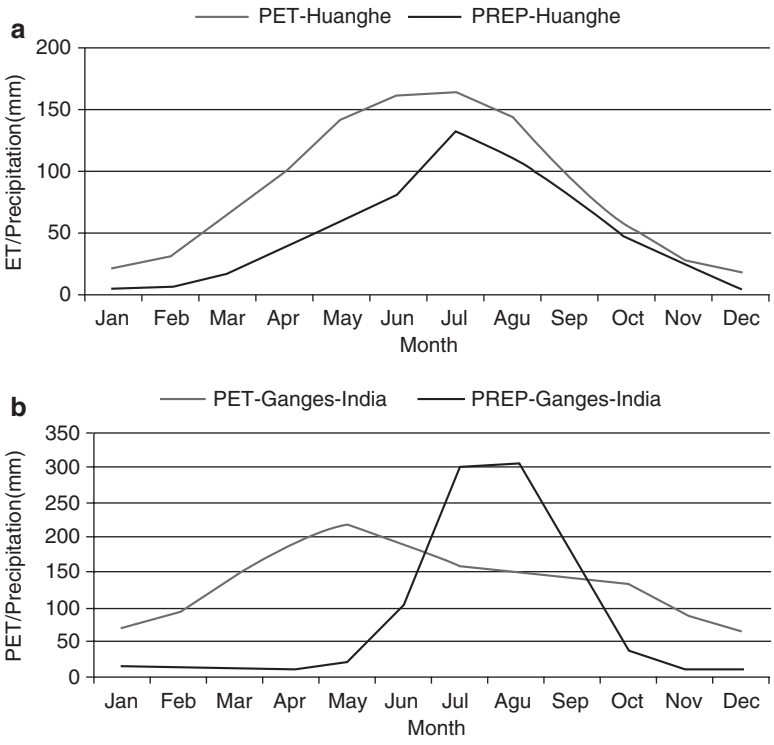


**Fig. 4.5** The monthly crop evapotranspiration (PET) and precipitation (PREP) in the Yellow River (Huang He) and the Ganges basins (*source*: Cai and Rosegrant 1999)

eastwards through the North China plains, it ends in the Bohai Sea. This heavily silt-laden river is 5464 km long. The Yangtze, also known as Changjiang, meaning the long river, originates from the Qinghai–Tibetan Plateau; it travels eastward for about 6400 km and ends near Shanghai in the East China Sea. Regular flooding in the lower stretches of both rivers provided the basic environmental conditions favorable for abundant harvest of food crops from sedentary agriculture. In course of time, this led to the growth of an early civilization.

The gradual growth and consolidation of agrarian villages and towns led to the establishment of the first ever dynasty in northern part of China, the Xia. The founder of the Xia dynasty, Great Yu (2200–2100 BC), had studied the Yellow River and Yangtze river systems with the objective of flood management and mitigation. In the year 2200 BC, following the Great Flood, he constructed drainage systems that substantially reduced the damage from floods in the lower stretches of the Yellow River and Yangtze basins. The middle and lower parts of the Yangtze basin is reported to be the original home of wet paddy cultivation while the Yellow River is described as the origin of dry land farming with foxtail millet and broomcorn millet as the most representative crops (Zhao 2011). Identifying the importance of the

Yellow River for China, Yu remarked, "who so ever controls the Yellow River, controls China." There is also a military significance of this statement. On many occasions the Yellow River has often been used as a weapon in war. Intentional breaking or cutting of the embankments had been practiced to generate floods with the objective of stopping the advance of invading enemy armies or destroying them by submersion.

The Xia Dynasty (2070 BC–1600 BC) was followed by the Shang Dynasty (1600 BC–1046 BC) and the Zhou Dynasty (1046 BC–770 BC). Approximate population living in the Yellow River and Yangtze basins around this time is reported to be 20 million (Yang et al. 2010) and five million (Zhang 2000), respectively. The period between 770 BC and 221 BC was a period of wars among the various dynasties and also the transition of China from a slave society to a feudal one. In 221 BC Qin Shi Huang (259–221 BC), a courageous and talented leader brought the warring dynasties under his singular control to become the first emperor of China and the initiator of the Qin dynasty. Gun powder and paper were invented in the Yellow River basin around this time.

After the Qin, China was ruled by several other dynasties, namely, Han, Sui, Tang, Song, Yuan, Ming, and Qing. Efforts at organized water management are recorded during the Tang dynasty, in the form of "Shuibushi." At the end of the Qing dynasty in 1912, western style parliamentary elections brought the nationalists to power and Sun Yatsen became the first President of China. However, the period was followed by further fights and instability. The war between the nationalists and the Communist Party of China ended with the victory for the communists. In 1949, the nationalists fled to Taiwan and the birth of the People's Republic was declared by Mao Tze-dong. All through the several millennia of Chinese history, the Yellow River and the Yangtze remained the main source of water for the large part of the population in China. For which the Yellow River basin is widely described as the 'cradle of the Chinese civilization' with Yangtze remaining an equally important support for that civilization in areas to the south, with Nanjing on that river often being chosen as the capital city of China. There are many important cities on the Yellow River, namely, Lanzhou, Yinchuan, Hohhot, Zhengzhou, Jinan, Dongying, etc. The dependence of the Chinese people on the Himalayan rivers and engineering interventions in them continued to increase in the period following the establishment of the Nationalist government of Sun Yatsen and the People's Republic. Large dams for flood moderation, irrigation, and hydropower generation were looked up to with great expectations. At the same time small-scale interventions based on the knowledge of the rural people constituted another line of thought and action (Pietz 2015: Chapter 1). Irrigation for food security, especially in the Hunag He and the Yangtze basin was a priority for the programs of the new Communist government.

The Sanmenxia dam on the Yellow River was built with Soviet support and the Three Gorges dam on the Yangtze was at the stage of survey and planning. The Sanmenxia dam was the first major structural intervention on the Yellow River and its image even got printed on the currency notes of China. The Three Gorges Dam on the Yangtze is another project that has received big support from the leadership of the People's Republic of China. The Yangtze is also now being used as a source

for the South to North Water Transfer project, feeding the densely populated and industrializing North China plains.

In the post-Mao era of economic liberalization and emergence of the period of high growth rates of GDP, Himalayan rivers not only became even more important for supply of water but also became highly polluted. This was especially the case with Yellow River. In the last two decades, policy makers of China have recognized the need for a new approach to the management of water in general, and the two Himalayan rivers, Yellow River and Yangtze, in particular. In the 12th Five Year Plan document of China, the growth of an 'ecological civilization' has been prominently declared as a national objective. The ecological restoration of the rivers, indeed, will be an indicator of progress in that direction. With this basis, a more detailed description of the policy changes on the Himalayan rivers will be made in later parts of the chapter.

### *4.2.2 The Himalayan Rivers in the History of India*

Large parts of South Asia have always been critically dependent on the rivers originating in the Himalaya. The Brahmaputra, the Ganges, and the Indus with their numerous Himalayan tributaries can be described as the lifelines for Bangladesh, north India, and Pakistan. Supported by the availability of river water and fertile silt carried by it, human settlements started and flourished on the banks of the Indus and the Ganges. The Ganges (2530 km) rises from the Gaumukh glacier in the Uttarakhand state in the Indian Himalaya. The river enters Bangladesh near the Indian city of Murshidabad and drains in the Bay of Bengal through a number of distributaries spread over the Bengal delta. The Meghna and the Bhagirathi-Hooghly are the main channels on the eastern and western ends of the Bengal delta that drain most of the flows of the Ganges–Brahmaputra–Meghna to the Bay of Bengal. The Indus (3,180 km) originates from the springs of Sengge Khabal near Lake Manasarovar in Tibet in China. It enters India in Ladakh region of the state of Jammu and Kashmir. It cuts through the Himalayan range in a deep gorge near Nanga Parbat and then leaves Jammu and Kashmir to enter Pakistan. It traverses through the length of Pakistan and finally drains into the Arabian Sea near the city of Karachi.

During 2600–1900 BC the prehistoric Indian civilization, commonly known as the Harappan civilization, developed along the Indus and its tributaries (Lahiri 2000). The name 'Harappa' came from that of the town on the left bank of river Ravi, a tributary to the Indus, where the archeological remains of this civilization were first located. The Harappan civilization was spread along the various parts of the Indus and its tributaries. The people cultivated wheat, barley, peas, and dates supported by irregular water supply from the rivers. At the port town of Lothal on river Sabarmati, rice was reportedly grown as early as in 1800 BC. The people of the Harappan civilization were the first in the world to grow cotton (http://www.historytuition.com/indus_valley_civilization/agriculture.html). At a more mature stage of the Harappan civilization, the rivers were used extensively for navigation and trade that extended

beyond the confluence of the Indus with the Arabian Sea. The river that provided the material conditions for the advancement of this ancient civilization is also described by researchers as an important factor behind its decline. Devastating floods and shifting of the rivers, very usual in the Himalayan context, have been attributed as important reasons behind the decline of the Harappan civilization. Whether the environmental disasters can also be partly attributed to impacts of human interventions into and use of natural resources, or they were part of the hydro-meteorological variability in the Himalaya, however, is not clear.

With the decline of the Harappan societies and continued arrival of migrating groups of humans from various parts of Central Asia / Eurasia to northern India, a new civilizational phase started, the age of the Vedic Civilization. The new migrants, who are broadly described as the Aryans, crossed the Indus and slowly moved in southeastern direction of the seven rivers or the *Saptasindhu.* This expansion further took place into the land between the Yamuna and the Ganges. The Vedic people colonized the middle Gangetic plains during the second half of the first millennium BC (Jha 1998). In course of time, by the sixth century BC, some of the earliest settlements along the banks of the Ganges developed as powerful states known as *Mahajanapadas*.

Of the 16 or *Solasa Mahajanapadas* the more important were Kasi, Kosala, Anga, Avanti, and Magadha. The capital of Anga was at Champa on the confluence of the rivers Champa and Ganges that flourished as a center of trade and commerce and was one of the greatest towns of the time. The capital of Magadha was Pataliputra, which stood at the confluence of the river Sone and the Ganges. Magadha, eventually secured absolute political control over the Ganges basin and claimed the glory of being the first empire in north India. The flat and fertile floodplains of the Ganges basin had been at the core of the various empires that followed, like that of the Mauryas, the Guptas, the Sultans of Delhi, and finally the Mughals. All of these empires had their demographic, economic, and political centers in the Indo-Gangetic plains. Water management and transfer were practiced by the rulers of the region since a long time. The Yamuna irrigation canal was built in the fourteenth century AD and the Mughal rulers (sixteenth to nineteenth centuries) large-scale run-of-the-river schemes (Briscoe and Malik 2006: 1). Due to its great support to advancement of human societies and civilizations in India, the river Ganges is revered as the 'Mother River.'

The establishment of the rule of English East India Company in Eastern India after 1757 and then the direct rule of the British Crown in 1858 over large parts of northern and eastern India increased the scale of human interventions in the river systems. The main objective was expansion of canal irrigation, which was particularly exemplified by the construction of the Upper Ganges Canal linking Haridwar in the Himalayan foothills with Kanpur and Etawa through the fertile and densely populated Gangetic plains. These were built with the objective of providing irrigation in the Ganges–Yamuna doab, the land between the two rivers. The total length of this canal system is about 17,700 km. The East India Company, and later the British Government, selected Calcutta and then Delhi as the capital of the British empire. Calcutta is located on the Bhagirathi-Hooghly branch of the Ganges and Delhi on the Yamuna, a tributary to the Ganges. Today, between Calcutta and Delhi, along the Ganges and Yamuna, exists the world's most densely populated river basin

with several large cities of industrial and administrative significance, like Agra, Aligarh, Kanpur, Allahabad, Varanasi, Patna, etc.

Independent India had given top priority to large-scale engineering interventions in the rivers originating from the Himalaya. The Farakka barrage on the Ganges was commissioned in 1975 to increase the flow in the Ganges-Hooghly branch of the river that flows to the Bay of Bengal through India. The Bhakra-Nangal project on the Satluj was among the earliest major multipurpose interventions undertaken by independent India for irrigation and hydropower generation. Jawaharlal Nehru, the first Prime Minister of India described this project as "the temple of modern India." This trend of large-scale interventions continued for about three decades after India's independence. The basin of the Himalayan river Ganges accounts for about half of the irrigated area of India. However, 1970s onward popular protests against large river projects started to take place, mainly on the issue of inadequate rehabilitation of the involuntarily displaced people, and later on the ecological risks associated with the large dams, like the Tehri high dam, on the Himalayan river Bhagirathi in Uttarakhand (Bandyopadhyay 2002).

During the past four or five decades, dumping of wastes from human settlements, chemical pollution from intensive agriculture, and industrial wastes made the Ganges and the Yamuna largely unfit for human use. A detailed baseline study of the Ganges basin had been undertaken by the Central Pollution Control Board (CPCB 1982). Trivedi (2010) and Gopal and Sah (1993) have addressed the status of pollution and corrective measures for the rivers Ganges basin and Yamuna subbasin, respectively. Popular discontent against pollution and movements for restoration of water quality in these two rivers pushed the Government of India to start cleaning-up projects on these rivers. While such efforts are going on, the crucial importance of the Himalayan rivers in present-day India has, however, further increased over time, with population growth and expansion of economic activities. That the business-as-usual approach would neither be any more sustainable nor acceptable is being increasingly understood by the people and the policy makers in India.

## 4.3 Himalayan Rivers, Economic Growth, and Environmental Concerns in China and India

### *4.3.1 Himalayan Rivers and Water Scenario of China*

China is a geographically large country spanning over 9.6 million km$^2$ with a population of about 1.39 billion (highest in the world) and a projected GDP of 11.2 trillion USD in 2015 (second highest in the world). It has very high spatial and temporal inequity in precipitation and, what makes the situation more challenging, is the high inequity in the spatial distribution of arable land in the country. With its large population and rapid annual economic growth that remained steady at about 10 % for about three decades, concerns about the water futures have been fundamental to policy making and governance in China. China faces three distinct challenges

related to water: floods, scarcity, and pollution. The scale and nature of water-related challenges is well described by Pietz (2015: Ch 3.1) in the following words:

> *A quick glance at selected data gives a compelling sense of China's water challenges. For example, over 20 percent of the world's population lives in China, sustained by only 9 percent of the world's arable land. Rendering these pressures more acute is the fact that China has only 6 percent of the world's supply of freshwater. ….But China goes by. Until very recently the country has managed to feed itself despite imbalances in the population-land-water equation.*

The mean annual precipitation over China is 6189 BCM and the average depth of precipitation is 648 mm. The Yellow River and the Yangtze have remained as the most important rivers for China. However, the regional picture of water availability and use is even more astounding. The precipitation map of China shown in Fig. 4.6 makes the drastic regional imbalances very clear with southeast China receiving larger amounts of annual precipitation like 2000 mm and the North China Plain and the whole of western China receiving about 250 mm of precipitation. Liu and Xia (2004: 2201) have pointed out that:

> *In the four major basins in the North (rivers Liao, Hai, Huang and Huai) farmland covers 40.2 Mha accounting for 41 percent of the total farmland area in China, but the annual amount of river run-off is only 163 CuM, which is only 6 percent of the national total.... Consequently, water resource availability in time and space is very uneven, which points to poor availability of water supply under heavy demand due to rapid population growth and economic development.*

The level of inequity in the distribution of water and arable land is also reinforced by the fact that "total water volume available per unit of farmland on the North China Plain is 15 percent of the national average, while the region supplies over 40 percent of the nation's grain" (Pietz 2015: Ch 3.1). This area is the home of one-third of the population and the GDP of China with only 7.7 % of the available water of the country. "Between 1980 and 2007, total water use (in China) increased by about 32 percent. During this period, domestic water demand increased by 137 percent and industrial demand by 236 percent" (Sun et al. 2010: Chapter 2). Water consumption by industries and irrigation underwent a rapid increase, to the extent that during the 1990s the water withdrawing capability of the projects along the Yellow river totaled 6000 $m^3/s$, which is 3.4 times the average annual runoff of 1830 $m^3/s$ (Liu and Xia 2004: 2202). The irrigated area in the Yellow River basin has expanded from 1,402,700 ha in the 1950s to 4,840,700 in the 1990s, an increase of almost 3.5 times during the last five decades (Liu and Xia 2004: 2202) (Fig. 4.7).

China has so far managed to sustain its water supply by constructing very large number of storage structures, which have been described and commented upon by Gleick (2012). With limits on availability of river flows, industry, agriculture, and urban settlements started pumping groundwater. Gleick (2009: 86) observed that:

> *Overpumping and contamination of groundwater is forcing cities and business to dig deeper to find clean adequate supplies. In northern Hubei province villages are digging 120 to 200 meters to find clean drinking water; a decade ago wells were only 20 to 30 meters deep. Deep wells cost thousands of Yuans—as much as half the annual income of farmers (Guo 2007)*


**Fig. 4.6** Precipitation pattern and river basins of China (*source*: https://upload.wikimedia.org/wikipedia/commons/8/8d/China_precipitation.jpg, ICID 2005)

**Fig. 4.7** Yellow river at Hukou (Photo by Xunling Lu)

In the background of the large population of China and the rapid rates of economic growth of the country, the water future has drawn serious attention of both national policy makers and international institutions. The drying up of the Yellow River at the mouth so that it was unable to drain into the Bohai Sea and the drastic pollution of the rivers made popular discontent on its ecological status, in particular in the case of the Yellow River, and other rivers of China, in general. A large number of analysts have written on the present water situation in China. Ringler et al. (2010) have described the declining flows and ecological devastation in the Yellow River basin, while Economy (2010) has recorded the dangerous status of river pollution and its human impacts. Ma Jun (2004) makes a detailed analysis of the water problems of China, especially of floods and droughts. Mertha (2008) goes into the details of the people's movement on the issue of large water projects. In an analysis of water security in the Yellow River basin, Liu et al. (2014) have described the water security of the entire basin as in critical condition, including the insecurity and absolute insecurity state. Various international agencies have shared the concern over water in China and projected scenarios for future (Sun et al. 2010; Xie et al. 2009). In a recent article *The Economist* (2013) made quite a sensational and caustic picture out of the water situation in China by saying "Northern China is running out of water, but the government's remedies are potentially disastrous…ask an environmentalist what is the country's biggest problem, and the answer is always the same. "Water is the worst," says Wang Tao, of the Carnegie-Tsinghua Centre in Beijing, "because of its scarcity, and because of its pollution."" "Water," agrees Pan Jiahua, of the Chinese Academy of Social Sciences. "People can't survive in a desert." Wang Shucheng, a former water minister, once said: "To fight for every drop of water or die: that is the challenge facing China" (Fig. 4.8).

The Chinese Academy of Sciences have gone ahead addressing the scenarios of looming water crisis and have prepared a roadmap to 2050 for sustainable

**Fig. 4.8** Iron bridge over the Yellow River in Lanzhou City, China (Photo by Zhanhuan Shang)

water management (Liu et al. 2012). Policy makers at the highest level have identified clear goals for water in China. According to the 12th Five Year Plan, China "will cut water consumption per unit of value-added industrial output by 30 percent, and increase the water efficiency coefficient in agricultural irrigation to 0.53." The Opinion of the State Council of China entitled *Implementing the Strictest Water Resource Management System* (CPC 2012: 1) is a strict measure in favor of water conservancy and in the Guiding Principles advises all concerned:

> *to thoroughly apply the scientific outlook on development, we should strengthen water demands and water process management by focusing on water resources allocation, protection and conservancy. By sounding the systems, identifying responsibility, enhancing capability, intensifying supervising and strict control of water use amount, we could improve water use efficiency and keep gross pollution under control. Thus we could speed up the construction of water-saving society, promote the sustainable utilization of water resources and the change of economic development mode, which could in turn promote social and economic development in coordination with the carrying capacity of water environment, and make sure of smooth and quick development of long-term economic society.*

Announcement of such new policies that take the environmental sustainability very centrally was preceded by a number of research studies by academics and several popular movements. A report by The World Bank (Xie et al. 2009) makes a detailed analysis of the challenges in water systems management in China and recommends new institutional structures. Identifying the contradictions and challenges in China's water policy, Boxer (2001) stressed the limitations of the traditional approach and institutions using engineering structures as the main form of

interventions. Whatever the new approach be, the Himalayan rivers especially Yellow River and the Yangtze will remain central to the well-being of the Chinese people and growth of their economy.

In the background of the established fact that China is facing a great challenge in terms of its water management, this chapter analyzes the emergence and use of the concepts of 'environmental flows,' which has become a crucial innovation in the design of restoration of good ecological status of all rivers. However, these are not easy steps as has been pointed out by Bandyopadhyay (2011). The clarification and consolidation of the ideas and practice of environmental flows constitute a central tool for successful restoration of the rivers. In the following sections, the emergence of research and conceptual discourses on environmental flows and their application in China will be taken up.

### *4.3.2 Emergence of the Concepts and Practices of Environmental Flows in China*

In a monsoon-dominated climate, very high temporal variation in the flows is an unavoidable feature. Human efforts have always been aimed at moderating that variation and also to increase the spatial extent of the availability of water from the mainstream of the rivers. In the case of China, Yellow River and Yangtze have been extensively engineered with such objectives. Degradation of the ecological status of the natural ecosystems has been the result of such extensive interventions and transfers of water with traditional and supply oriented water engineering. The drying up of China's mother river, the Yellow River during part of every year for about three decades drew extensive environmental criticism from both inside China and outside (see Zusman 2000). In both summer periods of 1997 and 1998, the Yellow River failed to reach its mouth at the Bohai Bay for 226 days. The sediment dynamics in the Yellow River has been studied in details and human interventions are found to be the reason for low flows and the changed pattern of sediment deposition. Wang et al. (2007, 2016) have studied the impacts of reduction in the flow of water and sediments in the Yellow River basin. Global warming and climate change would add to the management problems of the Yellow River requiring wise adaptation strategies (UNESCO 2010).

In the spirit of a responsible scientific community, scientists in China tried to convert the problems into opportunities for institutional innovations. Jun and Chen (2001) provide a detailed framework for research in hydrological sciences in China and policy for China's rivers, in particular with respect to the regaining of their good ecological status. Over the past two decades or so, pushed both by environmental protests and by the governmental recognition of the priority of sustaining future water supplies, research and documentation on restoration of good ecological status of rivers have received growing attention and support in China. An account of the environmental activism in China has been recorded by Xie (2009). While thoughts about the ecological status of rivers are ancient, their conceptualization in the form of environmental flows is a recent innovation. It demands a high level of interdisciplinary knowledge

and provides the much needed space for participatory decision making. One of the early writings and a trend-setting one is by Dyson et al. (2003) which identifies environmental flows as part of the pristine flow in streams and rivers that are left in-stream to maintain a predecided suboptimal ecological status of rivers.

Many Universities, the various Institutes of the Chinese Academy of Sciences, the various river basin Conservancy Commissions, among others in China, have started work on diverse dimensions of integrated river basin management. Water is also a very important area of environmental activism of citizens, whether on the issue of environmental impacts of large water projects, extensive pollution or ecological destruction from overextraction and pollution, as in the case of the Yellow River. Governmental policy is often criticized by academic professionals as much by the environmental movements. On many issues, the opinions of many University faculty members and researchers in the Academy have not been in support of governmental positions. Innovations often emerge after interaction of the government with the academic community and the people in general, a process which is long and difficult. Thus, continued campaign by environmental movements plays a significant role in pushing for research and innovation in governmental policy formulation. This is where the micro-level push for environmental sustainability gets an integrated expression as macro-level policy innovations.

The Three Gorges Dam on river Yangtze is an important case in point on this aspect. Andersen (2011) mentions that after a long struggle of NGOs and members of the academic community, the Chinese government relented on the criticisms against the Three Gorges Dam project and allocated a sum of about half of the project cost for taking steps to counter the negative environmental impacts of the project. Wang (2002) signals a fundamental change in the strategy for water management in China by stating that internalization of social and ecological dimensions in policy is only a matter of time.

Within the framework of the Five Year Plan documents, this new phase of water management in China will be guided by the Policy Document No. 1 (CPC 2011) and the Policy Document No. 3 (CPC 2012). It is directed that "the development and utilization of water resources should maintain river flow and reasonable lakes, reservoirs and the reasonable groundwater levels, to fully considering the basic ecological water demand and the maintenance of ecological health" (CPC 2012: Sec 4.3). A major demand side management strategy for industrial water use is to be practiced, with a period of growth in supplies till 2020 followed by a period of higher efficiency then onward (HSBC 2012). It is projected that by 2030 the limit to China's total water withdrawal will be 700 BCM (Fig. 4.9).

According to the Scientific and Technological Roadmap to 2050, an important part of China's future water strategy will be the recognition of environmental flows in rivers (Liu et al. 2012: 51). Following that past phase of expansion of storage, a phase of rapid increase in efficiency of that enhanced available volume of water and greater allocation to the environmental flows is expected. There has been significant level of research activity on finding suitable methodologies for the assessment of environmental flows. No single methodology has been accepted as applicable to all situations. Indeed, this phase is one of significant innovations in research on environmental flows and sustainability of river ecosystems in China.

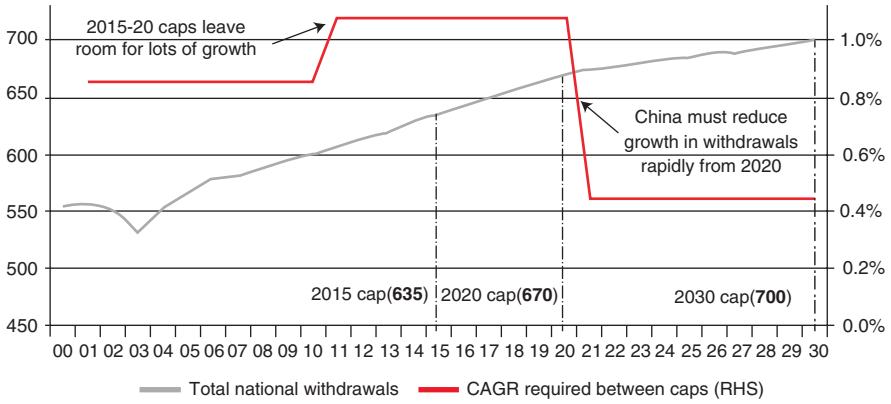


**Fig. 4.9** Water consumption schedule in China till 2030 (*source*: HSBC 2012)

### *4.3.3 Research on and Assessment of Environmental Flows for the Yellow River*

Rooted in the dominance of supply side management and uncontrolled dumping of pollutants in the rivers, a detailed backdrop of the ecological degradation of important rivers of China, like the Yellow River and the Yangtze, etc., was the emergence and growth of research and practice of environmental flows in China. A very useful introduction to the diverse management challenges in the Yellow River, including impacts of climate change, has been presented by Kusuda (2010). Wang et al. (2010) have provided a useful historical analysis of the work done on environmental flows in China. A significant factor in relation to the degradation in the ecological status of rivers, like the Yellow River, is the fact that "between 1986 and 2006, water volumes abstracted for human consumption from the Yellow River were maintained constantly at about 30 BCM—about 60 percent of the natural runoff volume of the Yellow River (45 BCM while the amount of the incoming pollutants to the Yellow River doubled" that "greatly weakened the river's ability to flush sediments through and dilute pollutants" (Wang et al. 2010). This is a clear example of the conflicts over water allocation between water needs for sustaining the ecological status of the rivers and the requirements of a rapidly growing economy.

Research interest in conceptualizing and using environmental flows in China date back to the 1970s when addressing the problems of water pollution became a challenge. One of the very early studies worked on the environmental flows needed to dilute and transport pollutants in the Yangtze river. Regulated discharge from the reservoirs to suit the needs of the downstream parts of the rivers was attempted as an early step toward providing environmental flows (Fang 1988). Another Himalayan river, the Tarim in northwest China, which had an annual flow of 1.353 BCM in the 1960s, carried only 0.267 BCM in the 1990s, amounting to a decline of flow by 80 % in 40 years. This reduction caused rapid decline in groundwater levels and loss of desert biodiversity (Chen et al. 2008). Speed et al. (2011) have made an important contribution toward

analyzing the need for the assessment of environmental flows and mechanisms for their applications, through a number of case studies, including one on the Yellow River.

Assessment of environmental flows has been undertaken in several rivers of China but the focal area has been the lower stretches of the Yellow River. However, most of these studies like of Sun et al. (2008) have used simple hydrological and hydraulic rating methods, with little linkage with the aquatic species and their needs of water flows. Jiang et al. (2010) have used a holistic approach using multiple modules to recommend environmental flows for fish in the lower Yellow River basin. They mention that a local migratory fish species like *Coilia ectenes*, that was abundant in the past, are now extinct or endangered due to flow alteration or absence of it. Work on standards of economic compensation for release of water from agricultural uses by different stakeholders among upstream users of water so that the identified environmental flows may be actually allocated in the downstream areas is going on. In a more recent work, Pang and Sun (2014) have used Bayesian networks considering the conflicts between agriculture and status of the aquatic ecosystems for decision making on environmental flows. They also make an application of their approach on the Yellow River. Taking a wider perspective, Song et al. (2007) take an approach that adds the processes of self-purification of river waters and the crucial question of sediment transportation in the Wei river, the largest tributary to the Yellow River. Sun et al. (2012) have developed an objective-based method for the assessment of environmental flows in the Yellow River estuary.

A detailed study on the environmental flows assessment of the lower reaches of the Yellow River, from the Xiao Lang Di reservoir to the estuary has been done by Gippel et al. (2012). This work explains in details the diversity of environmental flows and the complexity of the assessment processes. The report identifies a number of flow-related issues for the lower Yellow River as follows:

- Declining water availability
- Sedimentation of the channel
- Sediment balance of the delta
- Lowering of the quality and extent of the riverine wetlands
- Alteration of the estuarine processes
- Impacts of water quality on the ecological health of the river

The project does not arrive at a single environmental flow that will take care of all the needs of the ecosystems. More in line with the original thinking expressed in Dyson et al. (2003). Gippel et al. (2012) do not "recommend a single environmental flow regime as being 'ideal' for the environment." They derive:

> *a range of environmental flow options with varying implications for meeting river health and utilitarian objectives. The approach relies on balancing the flow needs of different users using input from water resource managers, together with other stakeholders as appropriate using the science-based information provided by the environmental flow assessment. The entire process ultimately determines the environmental flow regime that will be implemented in a river.*

The importance given to environmental flows in the case of the Yellow River offers the plans for the restoration of its good ecological status a good prospect of success in future. If this is done, especially with full participation of all stakeholders, the very important task of the establishment of an ecological civilization in China can become a reality in due course of time.

### 4.3.4 Himalayan Rivers and Water Scenario of India

India extends over an area of 3,287,263 km$^2$ and has a population of about 1.29 billion (second highest in the world) with a projected GDP of about US$ 2.18 trillion in 2015 (seventh highest in the world). With an annual average rainfall of 1170 mm, India receives an average annual precipitation of about 4000 BCM. India has more than 17 % of the world's population but has only 4 % of the global renewable amount of water and 2.6 % of the land area of the world (MOWR 2012). The precipitation over India is highly skewed over space and time. For example, average annual rainfall in the western parts in the State of Rajasthan is as low as 200 mm while that in the eastern State of Meghalaya can be as high as 11,000 mm. The mean annual runoff has been estimated as 1953 BCM, of which 690 BCM is considered utilizable. The volume of annual replenishable groundwater is about 432 BCM. The total volume of annual utilizable water in India is about 1122 BCM (CWC 2005) but Chaturvedi (2001: 303) puts this figure for year 2050 as 1276 BCM. The three Himalayan river basins that fall within India in parts are Brahmaputra, Ganges, and the Indus. They account for 1183 BCM (including Barak) out of the total annual surface water potential of India which stands at 1869 BCM. These three rivers have an annual utilizable flow of 553 BCM when compared with India's total annual utilizable flow of 1122 BCM (CWC 2005). Thus, the Himalayan rivers provide about 50 % of the total utilizable flow and carry about 72 % of the annual surface water potential of India. Thus, in meeting any future requirements of water in India, the Himalayan rivers have a great importance. However, one precondition clearly articulated by Briscoe and Malik (2006) is that, in promoting effectiveness of policies, the question of institutional reforms has to be addressed. In particular, they stress the need for open access for all to river data, without which the science of the Himalayan rivers will not grow rapidly.

The present-day setup for water management in India has a long and clear colonial root, with its advantages and otherwise. As Chaturvedi (2001: 299) put it:

> *A constellation of political, technological, financial and administrative led to the policy and technology of providing an apology of irrigation to stabilize the subsistence agriculture and mitigate famines….A colonial-bureaucratic institutional system was established. Water, as the entire socio-political economic activity, was the business of the government, and not the people.*

The paradigm of European water management of the nineteenth century dominated India's river management education and practice in India. Stalwarts like Rao (1975) emerged from this paradigm and made significant contributions to increasing the supply of water for irrigation and food security. Figure 4.10a presents the precipitation pattern and the river basins draining India. According to the Ministry of Water Resources of India, the water requirements of the country for 2025 are projected as 1093 BCM and for 2050 as 1447 BCM (IDSA 2010: 9). The challenges of water management would become even more difficult as river flows, especially of the Himalayan rivers, are to undergo serious impacts of global warming and climate change (Whitehead et al. 2015; Majumdar 2008). Kumar et al. (2005) have analyzed the achievements and challenges in water management in India, particularly those related to the built-in variability in a monsoon-dominated climate. In terms of the

emerging challenges in water systems management in India, Chaturvedi (2012) presented a detailed analysis while Kumar et al. (2005: 810) have pointed out that:

> *Water…is likely to become critically scarce in the coming decades,… due to rapid increase in population and expanding economy of the country….uneven distribution of precipitation results in … floods and droughts affecting vast areas of the country. Better and scientific structural and non-structural measures are required…There is a need for increasing the*

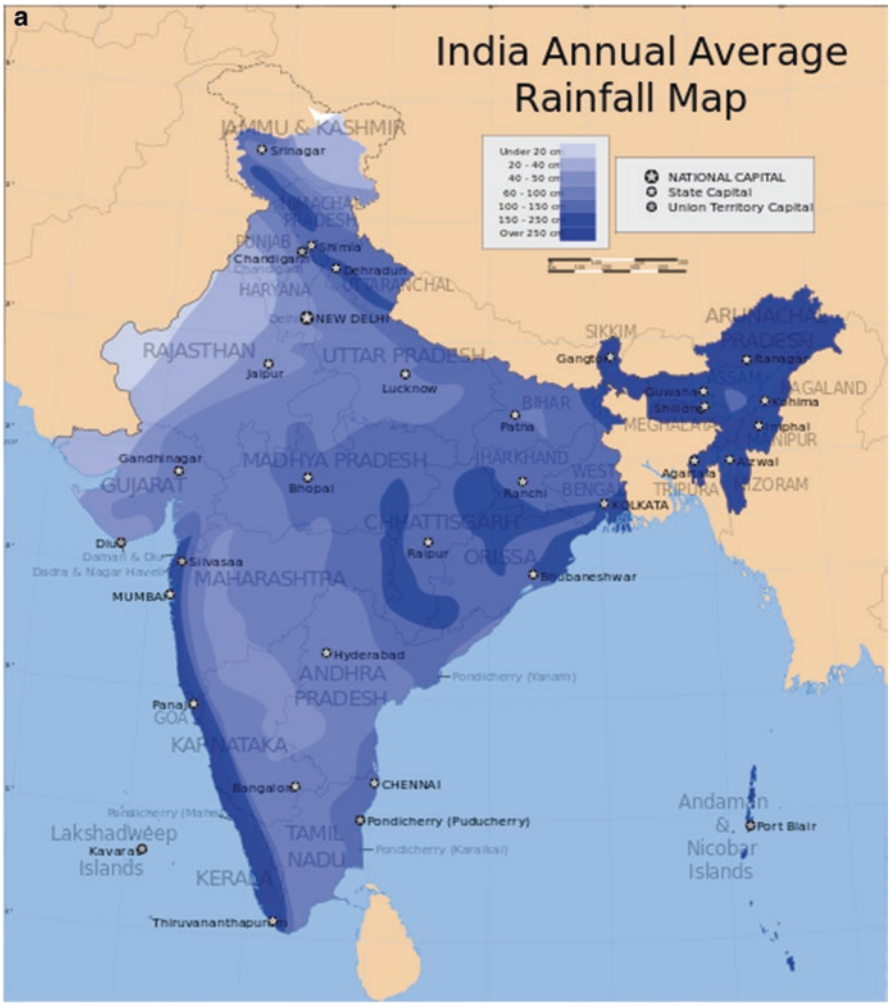


**Fig. 4.10** Rainfall distribution (**a**) and river basins (**b**) of India (*source*: (**a**) https://upload.wikimedia.org/wikipedia/commons/thumb/a/a7/India_annual_rainfall_map_en.svg/530px-India_annual_rainfall_map_en.svg.png. (**b**) http://www.bing.com/images/searchq=india+precipitation+map&view=detailv2&id=501607CC2F31E2B36B00467AA213D29784ADFFD3&selectedindex=1&ccid=h9GbjlSX&simid=608045113710347823&thid=OIP.M87d19b8e5497cdf8c8f740ed668d0956H0&mode=overlay&first=1)

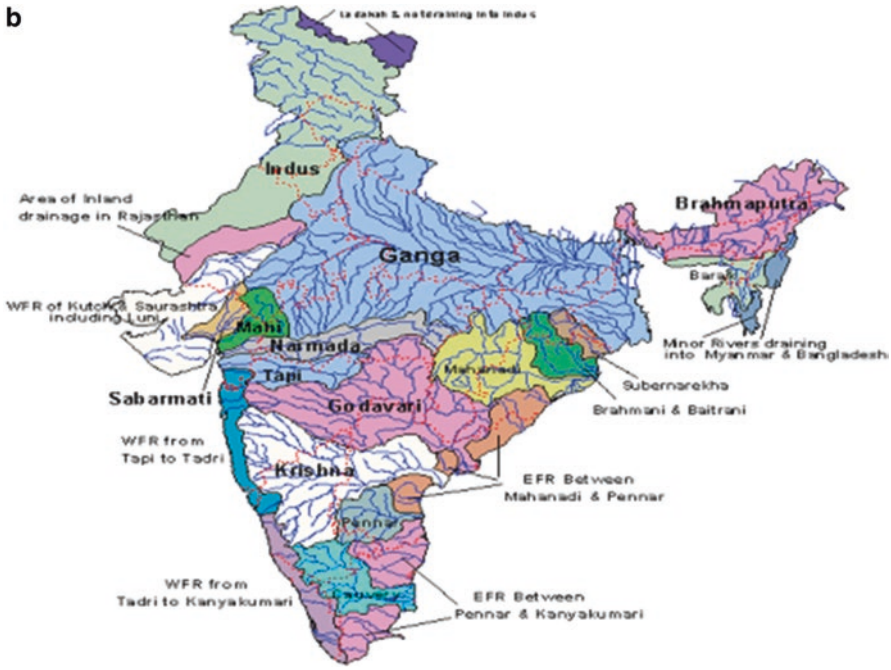


**Fig. 4.10** (continued)

*availability of water and reducing its demand. For increasing the availability of water there is a need for … additional storages by constructing small, medium and large sized dams considering the economic, environmental and social aspects. The availability of water resources may be further enhanced by rejuvenation of dying lakes, ponds and tanks.*

It may be noted from the earlier, that attention to the reason for ecological restoration of degraded water bodies is still given from the point of supply side augmentation. In addition to the issue of growing demand but little demand management, the decline in water quality in the rivers has further reduced the available supplies. The Ganges basin generates 2723 mld of sewage and the treatment capacity is only 1209 mld. Also 764 grossly polluting industries in the Ganges basin generate 501 mld of wastewater (CPCB 2013: Executive Summary). The World Bank (2011: 6) has commented that "the pollution in the Ganga is primarily a result of inadequate infrastructure, the weak capacity of the local water and wastewater utilities in the basin and the poor environmental monitoring and regulation." The need for a new paradigm of water science (and a culture of harmony has been recognized by nongovernmental scholars) (Bandyopadhyay 2012; Iyer 2007). Efforts have been made toward generating a new and updated policy framework for India (see Iyer 2011). The National Green Tribunal, a body that is particularly responsible for environmental litigations, has taken a very strong view of the continued pollution of the Ganges and ordered strict penalties for the violators of pollution norms (Press Trust of India, 28 December 2015) (Fig. 4.10b).

A more recent but widespread human intervention in the Himalayan rivers of India has come in the form of hundreds of hydropower plants, functioning, under construction, and at the planning stages. The hydropower potential of the Ganges basin is officially projected at 20,711 MW, while installed and under construction plant capacity is about 6100 MW (http://india-wris.nrsc.gov.in/wrpinfo/index.php?title=Ganga#Hydrologic_Network). Hence, a lot of interest has been directed toward the construction of new hydropower projects. According to the Ministry of Water Resources (2014: iii, 66) "there are 784 dams situated in the Ganga basin, out of which 158 are listed in the National Register of Large Dams (NRLD) and 66 barrages, 92 weirs and 45 lift (irrigation) schemes are also constructed in the basin." In addition, there are 39 hydropower projects in the Ganges basin. Krishna Murti et al. (1991) have provided a scientific analysis of the Ganges river basin (Fig. 4.11).

The rapid expansion of dam construction, especially on the Himalayan rivers of Ganges and Brahmaputra, brought in an important dimension to the debate. The policy debate around large dams on the Himalayan rivers was invigorated with the proposal for construction in the Uttarakhand state of the Tehri High Dam on the river Bhagirathi, a tributary to the Ganges (Bandyopadhyay 1990, 1995). The issue of environmental sustainability and flows of the river became a significant element in the debate. Thus, the awareness of environmental flows in India was more a result of the discontent over risks associated with large dam projects on the Himalayan rivers, as opposed to the question of pollution in these rivers. For reasons of popular

**Fig. 4.11** The headwaters of Ganges (Photo by Shikui Dong)

culture and practice of millions of people bathing in the Ganges, depollution of the Ganges drew early attention of the Government of India as early as in 1984. Based on a background document on the water quality status of the Ganges (CPCB 1982) the Ganga Action Plan was taken up. In September 1995 this was converted to the National River Conservation Authority. In 2009 the Government of India established the National Ganga River Basin Authority as an empowered planning, financing, monitoring, and coordinating authority for the Ganga river. It is hoped that in the near future the water quality problem of the Mother River Ganga will be gradually solved.

### *4.3.5 Emergence of the Concepts and Practices of Environmental Flows in India*

Discussions on the need for allocation of environmental flows in India have been taken up first, from the viewpoint of diverse uses of river waters and related stakeholders (see Bandyopadhyay 2009; Gopal 2012). The dimensions, like flows for sediment transport, geomorphology, and fisheries, were shadowed by the towering importance given by the governments to water supply for irrigation, as provider of food security. The issue of quantitative allocation, especially in regard to the cumulative impacts of the hundreds of dams and assessment of the damage to downstream ecosystems and economies emerged in the early 1980s as an important factor. The growing scientific understanding of the nature of damages in the downstream areas, through the concept of environmental flows have generated widespread public criticisms, that, analysts find to be a result of an absence of recognition of environmental factors from the governments (Swain 2015). In this background, how environmental flows are conceptualized in India and what are the uses of these concepts in practice are an important area of policy research and study. Among the early initiatives on environmental flows is one from IWMI (2004), which undertook in 2004 a global survey on the concepts of environmental flows (Fig. 4.12).

### *4.3.6 Research on Concepts and Assessment of Environmental Flows for the Ganges*

The concept of environmental flows in India has emerged in a few directions, some of which are simplistic and do not really provide dependable assessments. Bandyopadhyay (2011) and Gopal (2013) have tried to reduce the gaps and inconsistencies in the understanding and strengthen the initial ideas of Dyson et al. (2003). A review of the various approaches to assessment of environmental flows in India shows that empirical study of environmental flows in rivers of India is not

**Fig. 4.12** Fisherfolk fishing in the Sundarbans delta of Ganges in India (photo by Pankaj Sarkar)

many. The Ganges is the river on which studies have been made but, to the best of the knowledge of the author, have not been published in peer reviewed journals yet. In terms of project reports on environmental flows for the Ganges, the available documents are related to the flows that the existing or under construction hydropower plants should ensure. This includes a study by the Worldwide Fund for Nature—India (WWF 2012), which has made recommendations on the basis of a publication by Smakhtin et al. (2007) as mentioned in the Report of the Inter-Ministerial Group (IMG) (MOEF 2013: iv). The other two project publications on the environmental impacts of hydropower projects in the subbasins of Alaknanda and Bhagirathi (both Himalayan tributary to the Ganges) are by IIT Roorkee (IITR 2011) and WII Dehradun (Rajvanshi et al. 2012). Based on all the three documents, the Inter-Ministerial Group on Issues Relating to River Ganga constituted by the Ministry of Environment and Forests have proposed environmental flows for the tributaries, Alaknanda and Bhagirathi. This, indeed, is the first-ever governmental proposal for environmental flows in the Ganges (MOEF 2013: v). The proposed environmental flows are as follows:

1. During the high flow period of May to September: 25 % e-flows of daily uninterrupted flows in the river with the stipulation that the total inflow in the river would not be less than 30 % of the flows in this season.
2. During the average flow period of April, October, and November: 25 % of the daily uninterrupted river flow during these months.

3. During the lean flow period of December to March: 30 % of the daily uninterrupted river flows with 50 % of such river inflows for those hydropower projects, where the average monthly river inflow during the lean season is less than average monthly river inflow of the high flow season and 40 % where it is between 10 and 15 % in the above season.

The methodology that led to this pioneering decision, however, is faced with serious questions from the world community of scientists working on environmental flows. Questioning the percentile flow approach, several years back Arthington et al. (2006: 1312) have pointed out that:

> *in an effort to provide immediate advice on flows for river ecosystem protection, some scientists are returning to simple hydrological "Rules of Thumb" that purportedly associate degrees of flow modification with likely ecological outcomes. Recent proposals include … environmental flow prescriptions for world rivers based on a percentage of total annual base flow plus a high flow component derived as a percentage of mean annual runoff (Smakhtin et al. 2004) … Such simplistic guides have no documented empirical basis and the temptation to adopt them represents a grave risk to the future integrity and biodiversity of the world's riverine ecosystems… Indeed such static rules defy fundamental understanding of the critical roles of flow variability in sustaining riverine ecosystems.*

Indeed, an application of the environmental flows as proposed by the IMG based on the three studies may not serve the interest of all stakeholders, and in future, may become the reason for causing damage to the ecological status of the Ganges. This would surely open up new areas of environmental disputes and conflicts, instead of solving the existing ones. There cannot be a compromise in river science while dealing with very important rivers like the Ganges. Thus, there is a need for taking a holistic view on the assessment of environmental flows of the Ganges, as much other rivers in India by responding to the published scientific criticisms as above before acting on such proposals.

## 4.4 Concluding Remarks

### *4.4.1 Beyond Growth Fundamentalism: Holistic Water Science, Institutional Innovations and Participatory Institutions for the Himalayan Rivers*

The chapter has taken the readers through long periods of history and use of water of Himalayan rivers like the Yellow and the Ganges by the people in China and India. The application of environmental flows assessment in China focused on the delta and the estuary of the Yellow River, while India has located assessment of environmental flows at the Himalayan watersheds of the Ganges. Both countries are presently at a crossroad where they can chart out a new approach to sustainable well-being of their people and the natural environment. For this, the economic policies guided by growth fundamentalism will need drastic modifications. Increasingly

the need for charting a new pathway to human well-being with a high priority to environmental sustainability has been recognized in policy documents. In this crucial juncture, three important elements are going to play central roles. First, immense amounts of public awareness on issues related to sustainability in general, and rivers in particular, are to be generated. For this public participation and extensive public debate will be a prerequisite. Innovations that are based on holistic scientific knowledge are to be promoted, especially in relation with the Himalayan rivers of China and India, like the Yellow and the Ganges. Research collaboration among researchers in the relevant subjects will be essential. The new interdisciplinary approach to the governance of river basins need institutional innovation, to move forward from very traditional ones that have existed during the decades after the establishment of independent Republic of India and the People's Republic of China. The new age will be of participation in river basin management, of all stakeholders in a process guided by a common commitment for the restoration of good ecological status of the rivers, which is the only way to realize sustained human well-being in the two countries. China and India have the great opportunity to think of and put into practice a human–nature relationship, which is different from that espoused by the traditional Euro-centric vision of human future, led by the single parameter of economic growth.

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# Chapter 5
# Himalayan Grasslands: Indigenous Knowledge and Institutions for Social Innovation

**Shikui Dong**

**Abstract** This chapter presents the importance of the Himalayan grasslands in terms of ecosystem services provided for both upstream and downstream people and the environmental problems associated with grassland degradation in the Himalayan region. Over half of the total area of the Himalayas support about 150 million people for their livelihood in the upstream regions, and three times as many people living in downstream regions with the important ecosystem services they provide. The sustainability of the Himalayan grasslands has significant impacts on both upstream and downstream populations. However, environmental degradation associated with human overexploitation and climate change has been challenging the sustainability of the Himalayan grasslands. Building on the case studies from grassland ecosystems and pastoral societies across the Himalayan countries, China, India, and Nepal, this chapter argues and illustrates that the indigenous knowledge and local institutions are critically important to promote the sustainable grassland management in the Himalayan region. The local pastoralists in the Himalayan region have developed adaptive strategies through social innovations to mitigate environmental challenges and socioeconomic pressures. Adjustment of grazing practice and grassland management is a key adaption strategy derived from evolving traditions of pastoral communities with environmental and social-economic changes.

**Keywords** Himalayan grasslands • Nepali Himalayas • Indian Himalayas • Qinghai-Tibetan Plateau • Social innovation • Local institution • Indigenous knowledge

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S. Dong et al. (eds.), *Environmental Sustainability from the Himalayas to the Oceans*, DOI 10.1007/978-3-319-44037-8_5

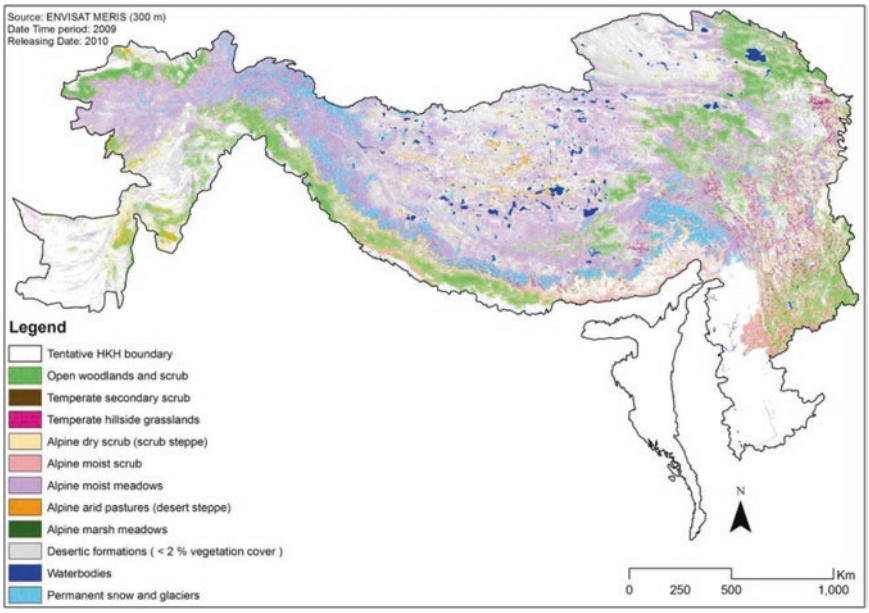


**Fig. 5.1** Map of Hindu Kush Himalayas and its grasslands (ICIMOD 2010)

## 5.1 Introduction

The Himalayas or broadly termed as the Hindu Kush Himalayas (HKH) is the world's highest mountain region, covering a 3500 km long complex landscape of mountains, plateaus, river gorges, and plains. With an area of 4.3 million km$^2$, the HKH is most populous mountain region, which sustains about 150 million people and impacts on the lives of three times as many people living in downstream regions (Schild 2007). Politically, the region comprises all or part of eight countries, ranging from northern Afghanistan and Pakistan in the west to northern Myanmar and Bangladesh in the east, and from the Tibetan Plateau of China in the north to the Ganges Basin in the south, and covering whole Nepal and Bhutan in the center (Fig. 5.1). The largest land use system in this region the grassland (Miller 1996), which is also termed as the rangeland in most literatures, is the land area on which the indigenous vegetation (climax or natural potential) consists predominantly of grasses, grass-like plants, forbs, and shrubs (Society for Range Management 2001). Around 60 % of the HKH's landscape is covered by the grassland/rangelands with 40.09 % of coverage in China (at the top among HKH countries) and 0.45 % of coverage Bhutan (at the bottom among HKH countries) within the portion of the HKH region (Table 5.1).

Types of the grassland in the HKH region vary from the temperate hillside grasslands in the low elevation mountains, to alpine meadows in the high elevation Himalayan Mountains, to the desert steppes of the Kunlun Mountains in west

**Table 5.1** Extent of grasslands/rangelands with the portion of the countries in the HKH region

| Countries | Afghanistan | Bhutan | China | India | Nepal | Pakistan | Total |
|---|---|---|---|---|---|---|---|
| Area ($km^2$) | 291,880.87 | 17,419.636 | 1,545,542.4 | 169,381.09 | 77,826.664 | 188,118.4 | 2,290,169 |
| Proportion (%) | 7.47 | 0.45 | 40.09 | 4.39 | 2.02 | 4.88 | 59.41 |

**Table 5.2** Ecosystem services provided by the grasslands to human beings (modified from Dutilly-Diane et al. 2007)

| Scales | Ecosystem services | Benefits | Beneficiaries |
|---|---|---|---|
| Local | Improved hydrologic function | Higher pastoral productivity | Local pastoralists and agro-pastoralists |
| | Improved soil health | | |
| | Higher plant biomass | | |
| Regional | Underground water recharge | Increased water availability | Water users, hydropower industries |
| | Flood reduction | Less damage to infrastructure, agricultural lands, and human lives | State (public infrastructure), downstream populations |
| | Dust-storms reduction | Improved health, lower maintenance costs for infra-structure and industry, reduced damage to farming systems | Urban populations, governments |
| Global | Carbon sequestration | Mitigation of global climate change | Global population |
| | Plant and animal biodiversity | Healthier resources for future generations | Conservation groups, tourism industry |

(Fig. 5.1). The grasslands in the HKH provide ecological, economic, and cultural and spiritual services at local, region, and global scales (Table 5.2), e.g., they produce forage for livestock grazing; they provide wildlife habitat that sustains the flora and fauna necessary to support human well-being; they store and supply water resources by serving the origin places of major rivers in Asia including Tarim, Yangtze, Yellow, Lancang-Mekong, Nu-Salween, Dulong-Irrawaddy, Yarlung Zangbo-Brahmaputra, Ganges, and Indus rivers (Fig. 5.1); they maintain the stable and productive soils; they provide the mineral resources and products; they sequestrate and store the carbon; and they create natural beauty (Dong et al. 2010). Among them, biodiversity habitat maintenance, carbon storage, and water regulation are considered as primary ecosystem services from the grasslands to human beings (Dutilly-Diane et al. 2007).

Over centuries, the HKH's grasslands have been utilized by the pastoralists for mobile livestock grazing, which are usually termed as pastoralism (Fig. 5.2). As major ecosystem and important natural resource in the HKH regions, the grasslands are critically important for the pastoral populations they support, the ecological services they provide, the economic contributions they make to some of the world's poorest regions, and the long-standing civilizations they help to maintain in this unique region with rich cultural, linguistic, and religious diversity (Dong et al. 2011). Being located in the world's highest mountain chain, the HKH's grasslands are fragile, remote, isolated, shrinking resource base, and are susceptible to faulty management practices and environmental changes. Currently, the threats and pressures associated with human population growth, economic development, land use changes, and climate change are challenging professionals and practitioners to sustain and protect these invaluable social, cultural, economic, and ecological

**Fig. 5.2** Pastoral grazing in Chinese Himalayan region, Qinghai-Tibetan Plateau (photo by Shikui Dong)

assets, the HKH's grasslands. In this chapter, case studies from China, India, and intermediate nation, Nepal, will be integrated to illustrate the importance of indigenous knowledge and institutions for social innovation in the context of sustainable grassland management in the Himalayan region.

## 5.2 Grasslands in the Himalayas of China, India, and Nepal

### *5.2.1 Grasslands in the Chinese Himalaya*

China is the grassland-rich country in the world and ranks in the second position behind Australia. In China, there are $3.6 \times 10^8$ ha of grasslands with 17 types, covering about 40 % of nation's territory. The grasslands cover about 40 % of nation's territory in China, mostly in Northern and Western region. Of the total area under the grasslands, about 43 % falls within the Himalayan region of China, amounting to about $1.55 \times 10^8$ ha. Within the Chinese Himalayan region, the Qinghai-Tibetan Plateau (QTP), which is the highest and largest plateau in the world (Zhang et al. 2005), over 60 % of land territory is covered by the grasslands (Dong and Sherman 2015). The massive grasslands on the QTP constitute an important territorial resource, serving critical economic and environmental functions. In the Himalayan region on the QTP of China, the grasslands have annually provided around 260 billion yuan (Chinese currency) of ecosystem services including provision (food, fresh water, fiber, and fuel), supporting (nutrients cycling, soil formation, primary production), regulating (gas regulation, climatic regulation, flood regulation, water purification), and cultural (aesthetic, spiritual, recreational) services according to Xie et al.'s estimation in the year of 2003 (Table 5.3). There are big variations of

**Table 5.3** Ecosystem service values of grasslands on the Qinghai-Tibetan Plateau of China (from Xie et al. 2003)

| Ecosystem service values by grassland types and areas | | | | Service values by ecosystem function | | |
|---|---|---|---|---|---|---|
| Types of grassland/rangeland | Area ($10^4$ hm$^2$) | Service value ($10^8$ yuan/a) | Composition (%) | Ecosystem functions | Service value ($10^8$ yuan/a) | Composition (%) |
| Temperate meadow-steppe | 21.1 | 9.68 | 0.38 | Gas regulation | 36.03 | 1.40 |
| Temperate steppe | 171.5 | 47.72 | 1.86 | Climate regulation | 246.65 | 9.59 |
| Temperate desert-steppe | 43.2 | 6.15 | 0.24 | Disturbance regulation | 19.40 | 0.75 |
| High-cold/Alpine meadow steppe | 558.6 | 53.68 | 2.09 | Water regulation and supply | 2.77 | 0.11 |
| High-cold/Alpine steppe | 3737.4 | 332.22 | 12.92 | Erosion regulation | 152.42 | 5.93 |
| High-cold/Alpine desert-steppe | 867.9 | 52.97 | 2.06 | Soil formation | 11.09 | 0.43 |
| Temperate steppe-desert | 10.7 | 1.56 | 0.06 | Nutrition cycling | 376.90 | 14.66 |
| Temperate desert | 4.5 | 0.46 | 0.02 | Waste treatment | 454.50 | 17.67 |
| High-cold/Alpine desert | 596.8 | 1.85 | 0.85 | Pollination | 130.25 | 5.06 |
| Tropical herbosa | 1.0 | 0.51 | 0.02 | Biological control | 119.17 | 4.63 |
| Tropical shrub herbosa | 35.4 | 19.60 | 0.76 | Habitat | 645.72 | 25.11 |
| Warm-temperate herbosa | 2.7 | 2.23 | 0.09 | Food production | 349.19 | 13.58 |
| Warm-temperate shrub herbosa | 27.6 | 21.83 | 0.95 | Raw material | 13.86 | 0.54 |
| Lowland meadow | 7.9 | 4.28 | 0.17 | Genetic resource | 2.77 | 0.11 |
| Temperate montane meadow | 705.0 | 363.65 | 14.14 | Entertainment and culture | 11.09 | 0.43 |
| Alpine meadow | 5824.7 | 1607.97 | 62.52 | | | |
| Marsh | 37.2 | 25.42 | 0.99 | | | |
| Total | 126,532 | 2571.78 | 100.00 | | 2571.78 | 100.000 |

*Note*: yuan is Chinese currency; 1 yuan equals to 0.121 US$ in the year of 2003

ecosystem service values estimated by the grassland types, and the ecosystem functions across the region (Table 5.3). The grasslands on the QTP modulate the climate in the region, which is likely to have a significant effect on the climate in eastern and southwestern China, and further to the whole northern hemisphere and even the entire globe. Known as "Water Tower in Asia," the grassland ecosystems make up the environment for the headwaters of these river systems, and what takes place in these upper watersheds has a far-reaching effect on downstream areas in hydropower development and for irrigated agriculture (Harris 2010). The high altitude grassland ecosystems have immense alpine biodiversity including many breeds of domestic animals, which are unique in the world.

The grasslands on the QTP, in addition to Mongolia plateau and Xinjiang Mountain-basin, have been serving as one of the most important grazing lands in China since ancient times. The alpine meadow and steppe on the QTP are the productive grazing pastures, renowned for their vast verdant pastures and large yak, Tibetan sheep, and horse herds. Tibetan-dominated communities have lived on these grasslands as pastoralists or agro-pastoralists to raise the indigenous livestock for meat, milk, wool/hair, and hide productions over centuries (Long et al. 2008). Currently, extensive grazing of pastoralism is still playing key roles in sustaining local livelihood and regional economy, e.g., over 13 million grazing yak (over 90% of the world's total population) and about 42 million grazing Tibetan sheep (Long et al. 1999; Dong et al. 2012) are kept on the grasslands for pastoral productions in this region. However, pastoral production systems in the fragile and vulnerable landscapes of the QTP are being threatened by the massive grassland degradation resulted from breaking of coupled human-natural systems of pastoralism (Dong et al. 2012). The livelihoods of more than 12 million pastoralists and agro-pastoralists who live on the QTP will be directly impacted by grassland degradation, but the health and well-being of hundreds of millions more who live in agricultural and urban areas downstream also will be affected indirectly through dust-storms, floods, and droughts (Harris 2010). These critical situations are challenging the professionals and practitioners to develop innovative technical interventions and management strategies to halt the degradation and promote the resilience and sustainable use of the QTP's grassland resources.

### *5.2.2 Grasslands in the Indian Himalaya*

In India, there are about 12.4 million ha of grasslands (including shrublands and savanna), covering around 18% of nation's total land areas. The grasslands of the Indian Himalaya cover most areas of Jammu and Kashmir, Himachal Pradesh, Uttaranchal, high altitude areas of West Bengal, Sikkim, and Northeastern states. The grasslands in these areas vary greatly with the climatic and geographical conditions and the land use by different pastoralist communities. As there are non-standardized classification and definition for the grassland in India, the types and areas of the Indian Himalaya's grasslands vary significantly among different scholars.

**Table 5.4** Grasslands in the Indian Himalaya

| | Permanent pastures and other grazing lands | Alpine pastures and blank | Temperate grassland/pasture |
|---|---|---|---|
| Himalayan states | Area ($km^2$) (%) | Area ($km^2$) | Area ($km^2$) |
| Jammu and Kashmir | 1263 (3.34) | 131,587 | 1240 |
| Himachal Pradesh | 14,912 (32.8) | 17,296 | 10,240 |
| Uttaranchal | 1987 (3.71) | 8524 | 91 |
| Sikkim | 40 (0.55) | 1626 | 1030 |
| Northeastern states | 180 (0.33) | 12,335 | 500 |

*Source*: Land use Statistics, Ministry of Agriculture, GOI, (2007), and Lal et al. (1991)

According to Rawat's report (1998), the grassland vegetation in the Indian Himalaya include warm temperate grasslands, subalpine and cool temperate pastures (including silvo-pastures), alpine meadows, and the steppe or alpine dry scrub, which cover about 35 % of the Indian Himalaya's geographical area. According to official statistics given by Ministry of Agriculture, Government of India (2007), there are about 1263 $km^2$, 14,912 $km^2$, 1987 $km^2$, 40 $km^2$, and 180 $km^2$ permanent pastures and grazing lands in Jammu and Kashmir, Himachal Pradesh, Uttaranchal, high altitude areas of West Bengal, Sikkim, and Northeastern States, representing 3.34 %, 32.8 %, 3.71 %, 0.55 %, and 0.33 % of total lands areas in respective states. However, Lal et al. (1991) provide very different data about the areas of the grasslands/pastures/blank in these states (Table 5.4). No matter how many types and how large areas the Indian Himalaya's grasslands are, the ecosystem goods and services provided by these grasslands are critically important at local, regional, and global scales. The provisioning services provided by the grasslands such as livestock production are most crucial for the well-being and survival for the local communities, especially the pastoral communities. The benefits of climate control, water regulation, flood mitigation and erosion regulation, and carbon sequestration, provided by the grasslands occur at global scale, benefiting the downstream communities as well.

The Indian Himalaya's grasslands are predominantly used for pastoral livestock productions including meat, skin, wool and hair, and milk production. Migratory livestock grazing based on transhumant pastoralism and involves cyclical movements from lowlands to highlands to take advantage of seasonally available pastures at different elevation in the Himalayas is common throughout the Indian Himalaya from west to east (Sharma et al. 2003). Various pastoralist groups across the wide range of the Indian Himalaya's grasslands herd different types of according to variations of climate, environment, water and other natural resources, and geographical areas. These herding communities in the region include the goat and sheep herding Bakrawals of Jammu and Kashmir, the buffalo herding Gujjars in Kashmir, parts of Himachal Pradesh and Uttar Pradesh, the goat and sheep herding Gaddis, Kanets, Kaulis, and Kinnauras in Himachal Pradesh, the sheep herding Bhotias of Uttar Pradesh, yak herding Sherpas of Sikkim and Northeastern states. Some pastoralists in the Indian Himalayan regions are agro-pastoralists who cultivate the crops, besides rearing animals as the major portion of their household income (Sharma et al. 2003). All of these

pastoral groups continue a long-standing tradition of moving their livestock up to the alpine pastures of the high Himalayas for the summer and moving their livestock down to the low-lying Himalayan foothills in the winter, following the traditional routes of their forefathers. However, the natural and human drivers have resulted in grassland degradation and thus have negatively impacted local livelihoods. Some scholars reported that excessive grazing has led to considerable loss of vegetation and wide presence of weedy species of *Viburnum*, *Stipa*, *Sambucus,* etc. in alpine meadows of Kashmir, which has badly effected the pastoral production there (Shah 1988). Therefore, the urgent actions are needed to promote the technical and managerial innovations for sustainable development of the Indian Himalaya's grasslands.

### *5.2.3 Grasslands in the Nepali Himalaya*

Nepal is a landlocked Himalayan country, which is sandwiched between India in South and China in North. About 12 % of country's total territory of 147,181 $km^2$ are classified as either rangelands, pasturelands, or "grazing lands" (LRMP 1986), with most (about 97 %) being located in the hilly and mountainous areas of northern Nepal (Table 5.5). Although the grasslands are not dominating the nation's land cover in terms of land area, they provide significant ecological and livelihood values for Nepal's mountain societies. The grasslands contribute about 15 % of the forage production and support a great number of grazing livestock and wildlife. Herding of livestock (including buffaloes, zebus, yak, yak-cattle hybrids/chauri, sheep and goats) for milk, wool, hair, hide, blood production depends mostly on the grasslands and makes up a small but important part of farming practices for ethnic groups living in northern Nepal (Rai and Thapa 1993). In addition, the Nepali Himalaya's grasslands provide numerous ecosystem function values including climate regulation, water storage, biodiversity conservation, and carbon sequestration, as well as sites for tourism (Dong et al. 2007).

Although the physical, climatic, and vegetative variations in Nepal are often viewed as constraints for the evolution and development of sustainable natural resource management practices, including those for pastures, indigenous manage-

**Table 5.5** Distribution of grasslands in Nepal

| | Total land area | | Grasslands | | |
|---|---|---|---|---|---|
| Physiographic region | ha (000,000) | % of total land | ha (000) | % of total land | % of nation's grasslands |
| Tarai | 2.1 | 14.4 | 49.7 | 0.3 | 2.9 |
| Siwaliks | 1.9 | 12.7 | 20.6 | 0.1 | 1.2 |
| Middle mountains | 4.4 | 29.5 | 292.8 | 2.0 | 17.2 |
| High mountains | 2.9 | 19.7 | 507.1 | 3.4 | 29.8 |
| High Himalayas | 3.5 | 23.7 | 831.5 | 5.6 | 48.9 |
| Total | 14.8 | 100 | 1701.7 | 11.4 | 100 |

*Source*: Land Resource Mapping Project (LRMP 1986)

ment systems have capitalized on these variations and have converted constraints into opportunities (Tamang 1993). Over centuries, transhumance livestock grazing has been the dominant use of grassland resources by indigenous communities in remote mountains and valleys of northern Nepal (Alirol 1979). Migratory herding of yak, sheep, chauri, or other pastoral livestock at different altitude grasslands with seasonal movements has been well adopted by the ethnic groups such as Bhotias and Sherpas in middle Nepal, Tamangs and Kirats in eastern Nepal. It has been recognized that pastoral livestock production and sustainable grassland management will not be successful if the traditional knowledge of local pastoralists is ignored or overlooked (Chand et al. 1991). However, big gaps between what the local people practice and what the policy-makers, planners, and researchers know has resulted in social conflicts and resource degradation (Shrestha 2001; Dong et al. 2007). Furthermore, the stresses of climate change and social transformation are worsening these scenarios. Therefore, a network of interested professionals in policy agencies, educational and research institutions, and project planning and implementation organizations is needed to appreciate and learn the indigenous knowledge and institutions to develop innovative grassland management strategies in coping with environmental and social changes.

## 5.3 Case Studies on the Himalayan Grasslands

### *5.3.1 Research Design*

Since the impacts of environmental changes and social transformation are so far-reaching in the Himalayas' grassland areas, adaptive grassland management strategies must encompass a wide range of policy areas and economic sectors, involving many diverse approaches and actions that contribute to building the resilience of people and nature. Adaptive management links science to action in iterative cycles of experimental design and implementation, followed by critical appraisal of outcomes against theory and expectations. Management practitioners are expected to become experimental learners by systematically applying scientific knowledge and methods to their practices and, crucially, then revising their management practices based on these lessons (Stankey et al. 2005). Conceptually, adaptive management recognizes the importance of political decision-making in sorting out public values in the face of contradictory expert opinion and evidence (Lee 1993). But the focus of attention has tended to be on the scientific research and the process is typically driven by scientific researches (Stankey et al. 2005). Therefore, a comparative study research was designed to focus on the perception of local people and performance of local institutions involving in grassland management pastoral development, the mechanisms to combine their efforts to sustain the development of grassland management in coping with environmental change and social transformation across the Himalayan region.

This comparative study was carried out in different geographical locations of the Himalayan region, i.e., Himachal Pradesh of India, Rasuwa District of Nepal, and Tianzhu County of China (Fig. 5.3). Through this wide-region-covered study,

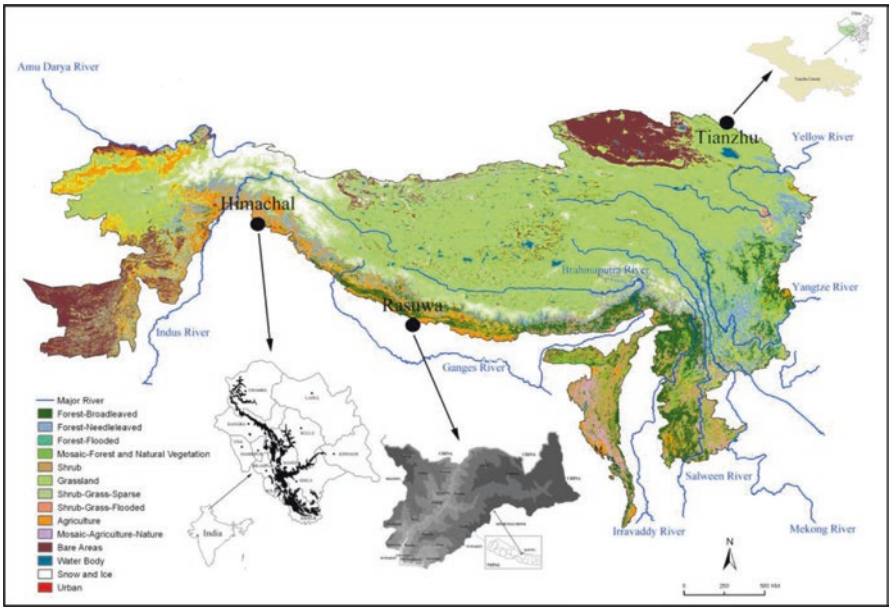


**Fig. 5.3** Case sties of Himachal Pradesh of India, Rasuwa District of Nepal, and Tianzhu County of China across Himalayan landscapes

we can compare: difference in impacts of the climate change and social transformation on the grassland management systems across the Himalayan region; difference in local institutional arrangement within pastoral society in coping with the climate change and social transformation across the Himalayan region; difference in suitability of adaptation strategies within political and social–economic contexts in local situation. The objectives of this comparative study are: to document and incorporate the indigenous practices of local pastoralists into sustainable grassland management under the climate change and social transformation; to better understand the linkages of social, economic, and ecological variables in sustainable grassland management in pastoral society to cope with the climate change and social transformation; to explore the coupled social and technical innovations arose from pastoral society to manage grassland resources more effectively under the changing environments. Here, different case studies from India, Nepal and China are summarized to formulate the feasible adaptation strategies to cope with climate change and social transformation in grassland management practices across the Himalayan region.

### *5.3.2 Case Sites*

The comparative case sites were selected from the typical grassland areas of the Indian, the Nepali, and the Chinese Himalayas, i.e., Himachal Pradesh, Rasuwa District, and Tianzhu County (Fig. 5.3). Himachal Pradesh is located in the western

Himalaya of India (30°23′02″–33°15′34″N, 75°36′41″–79°01′51″E), with altitude ranging from 350 m to 6816 m. There are five climatic zones: subtropical zone (below 900 m), warm temperature zone (900–1800 m), cool temperature zone (1800–2400 m), cold high mountain zone (2400–4000 m), and snow frigid zone (above 4000 m). The Scheduled Tribes including the Gaddis, the Gujjars, the Bholts, etc. in Himachal Pradesh are mainly involved in animal husbandry characterized with migratory grazing on native grasslands (Table 5.6). Rasuwa District is situated in the northwestern part of Central Nepal (27°57′30″–28°23′30″N, 85°7′00″–85°48′15″E), with altitude ranging from 614 m to 7227 m. This district is divided

**Table 5.6** General information about case sites

| Information about case study sites | Tianzhu County, China | Himachal Pradesh, India | Rasuwa District, China |
|---|---|---|---|
| Location | Northeastern edge of QTP in western China | Western Himalaya of Northern India | Northwest part of the Himalayan ranges in Central Nepal |
| Total areas | 7149 $km^2$ | 55,673 $km^2$ | 1515 $km^2$ |
| Terrain | High plateau | Varying from plain, valley, middle hill to high mountain | Varying from plain, valley, middle hill to high mountain |
| Elevation | 2787–4325 m | 350–6818 m | 614–7227 m |
| Climatic zone | Subalpine zone, alpine zone, snow-covered zone | Subtropical zone, warm temperate zone, cool temperate zone, cold high mountain zone, snow frigid zone | Subtropical zone, warm temperate zone, cool temperate zone, subalpine zone, alpine zone, arctic zone |
| Vegetation cover | Predominately shrub and meadow | Forest (low altitude), shrub (intermediate altitude), meadow (high altitude) | Forest (low altitude), shrub (intermediate altitude), meadow (high altitude) |
| Land use systems | Pastoralism, agro-pastoralism | Pastoralism, agro-pastoralism, crop farming, afro-forestry farming | Pastoralism, agro-pastoralism, crop farming, afro-forestry farming, tourism |
| Human population | 230, 000 (35 % are Tibetan pastoralists) | 6, 077, 248 (90 % are rural population) | 44, 000 (65 % are Tamang pastoralists) |
| Herding groups | Mainly Tibetans, a few Hans | Gaddis, Gujjars, Kanets, Bholts and Kinnauras | Mainly Tamang, a few Lamas |
| Livestock composition in individual household | 50–80 sheep, 40–60 yak | 1–2 cattle, 80–180 sheep/goats | 20–30 sheep, 2–3 horses, 10–15 yak and chauri |
| Environmental problems | Land degradation, water scarcity | Land degradation, weeds invasion | Land degradation, weeds invasion |
| Social problems | Conflicts with environmentalists, shortage of labors for pastoral production | Outmigration of young generation, conflicts with conservation groups and agricultural farmers | Outmigration of young generation, conflicts with community foresters and conservation groups |

into five climatic zones: subtropical zone (below 1000 m), warm temperature zone (1000–2000 m), cool temperature zone (2000–3000 m), subalpine zone (3000–4000 m), alpine zone (4000–5000 m), and snow cover zone (above 5000 m). This district is named as "grazing land for sheep and cattle" and represents pastoral areas of the Nepali Himalaya very well. The major population in this district is Tamang ethnic group, whose major production system is pastoral livestock grazing on native grasslands (Table 5.6). Tianzhu County is located in Northeastern edge of Qinghai-Tibetan Plateau of China (36°31′27″–37°55′20″N, 102°07′10″–103°46′10″E), with altitude ranging from 2787 to 4325 m. There are two climatic zones, subalpine zone ranging from 2700 to 3500 m and alpine zone ranging from 3500 to 5000 m. A great proportion of population in Tianzhu County are Tibetans whose livelihood is mainly pastoral livestock grazing (Table 5.6).

### *5.3.3 Research Methods*

Open-ended and pretested questionnaires, key-person interviews, and participatory rural appraisal (PRA) tools were used to survey the local pastoralists or agro-pastoralists, who were interviewed face-to-face as this is the most accurate method for surveying people who cannot read and write (Salant and Dillman 1994). The PRA developed by McCracken et al. (1988) and modified by Cornwall and Pratt (2004) was used to encourage farmers to give their knowledge, ideas, and opinions freely, and in such ways that the information missed in questionnaire surveys and key-person interviews could be supplemented. The group discussions were facilitated by local professionals who are familiar with the local communities and could freely communicate with them. Information such as indigenous grazing practices and grassland management, grassland institutions and governance, problems in pastoral production and livelihoods, solutions and strategies in sustainable grassland management were gathered through the use of questionnaires (Fig. 5.4), key-person interviews (Fig. 5.5), and group discussions of PRA (Fig. 5.6). The quality of the results of the questionnaires

**Fig. 5.4** Questionnaire survey in Rasuwa District of Nepal (photo by Shikui Dong)

**Fig. 5.5** Key-person interviews in Rasuwa District of Nepal (photo by Shikui Dong)

**Fig. 5.6** Group discussions of PRA in Himachal Pradesh of India (photo by Shikui Dong)

and interviews was controlled through careful checks on the errors in the completed surveys. Supplementary information were collected and recorded through literature review, personal communication with professionals and practitioners. The collected information and data were analyzed by following the methodologies proposed by Gibbs and Bromley (1989), Meinzen-Dick and Gregorio (2004) as well as Marshall (2004). Through the qualitative and quantitative analysis (Miles and Huberman 1994; Patton, 1990) we categorized the current managerial measures, management plans and policies for sustainable grassland management, examined the practical problems existing in application of these strategies, and the possible approaches to improve the grassland management strategies across the Himalayan region.

### *5.3.4 Case Study Results*

#### 5.3.4.1 Traditional Grassland Grazing Practices

From the cases in Himachal Pradesh of India, Rasuwa District of Nepal, and Tanzhu County of China, it can be found that pastoralism in the Himalayan region is based on transhumant practices and involves cyclical movements through fixed bypass from highlands to lowlands (or from lowlands to highlands) to take advantage of seasonal available pastures at different elevations, even across the national borders (Fig. 5.7). In summer, when the snow melts in the higher alpine pastures, the herders move up to them for grazing their livestock. In winter, they move down to occupy the low pastures for grazing livestock there. Herds are primarily moved at different climate patterns in a year to provide a consistent supply of feed, which is required for

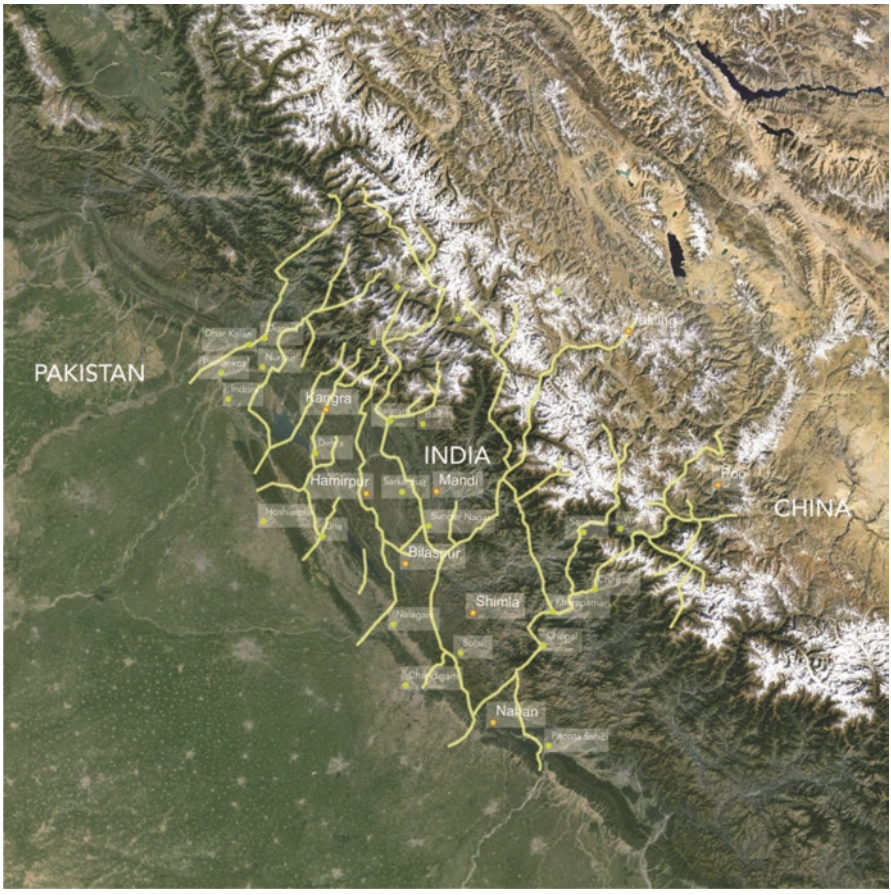


**Fig. 5.7** Migrative grazing routines of Indian herders in Himachal Pradesh across the borderlands (drawing by Victoria Marshall)

maintenance, movement, growth, production, and reproduction of the animals. Under these transhumant grazing systems, herders have adjusted the migratory routes, dates, and durations for grazing animals and pastures in response to variations in topographic features and climatic conditions, and the demand for forage and availability of pastureland (Fig. 5.8a–c). This is a kind of adaptive grazing management, which takes good advantages of annual climate variations (temperature and rainfall variations) along the elevation gradients for securing the feed supply.

Rotational grazing of the pasturelands according to feed availability is another good example of local knowledge adopted by the pastoral communities in the Himalayan region over centuries. In each type of pasturelands at different climatic zone, the grazing animals are moved from one plot to another in a time interval (every 10–15 days in the most cases) depending on the herders' estimates of grass cover, and the same plots can be repeatedly grazed during the same grazing season if the coverage and height of grasses have recovered. Local herders declared that such rotational grazing can protect pastures from being overgrazed and help increase forage production. The carrying capacity can also be estimated using a well-defined method among the herder groups to ascertain the stability of each pasture for a fixed number of animals. As part of their traditional grazing management practices, most herders in the case sites maintain only the number of animals that could be fed adequately using forages and fodder during the winter. The transhumant and rotational grazing systems practiced by local pastoralists have capitalized on the physical and climatic character and the plant communities of the grasslands and converted many constraints into opportunities in pastoral society.

In addition to seasonal movement and rotational grazing, the local pastoralists herd the different types of grazing animals at the same pasturelands one after another in a certain time interval or mix the different types grazing animals together to make full use of the feed resources by taking advantage of different feeding habitats of different animals. In Tianzhu County of China, local pastoralists herd the yak and sheep together in both alpine and subalpine pastures, so that the sheep can graze higher forages and the yak can graze the lower plants that cannot be taken by the sheep (Fig. 5.8a). In Himachal Pradesh of India, the goats are grazed on the shrubs at cold temperate and cold high mountain zones in different months, and the sheep are grazed on grassy forages in the warm temperate agroforestry, cold temperate conifer, or cold high mountain sub/alpine meadow (Fig. 5.8b). In Rasuwa District of Nepal, the local pastoralists graze the different animals at the same types of pasturelands in a time interval (Fig. 5.8c), e.g., in summer, the buffalos graze the hygrophilic forestry just 10–15 days later after the local goats move from this pastureland to higher pastureland, the zebu cattle graze the oak forest just 15–20 days after the sheep move from this pastureland to subalpine meadow, the yak and Tibetan goats graze the alpine meadow just 10–15 days after the chuari move from this pasturelands to lower pastureland. In this way, the local pastoralists can secure the ecological niches required by the different grazing animals, which can compensate the difference of their ecological niches (feeding habitats).

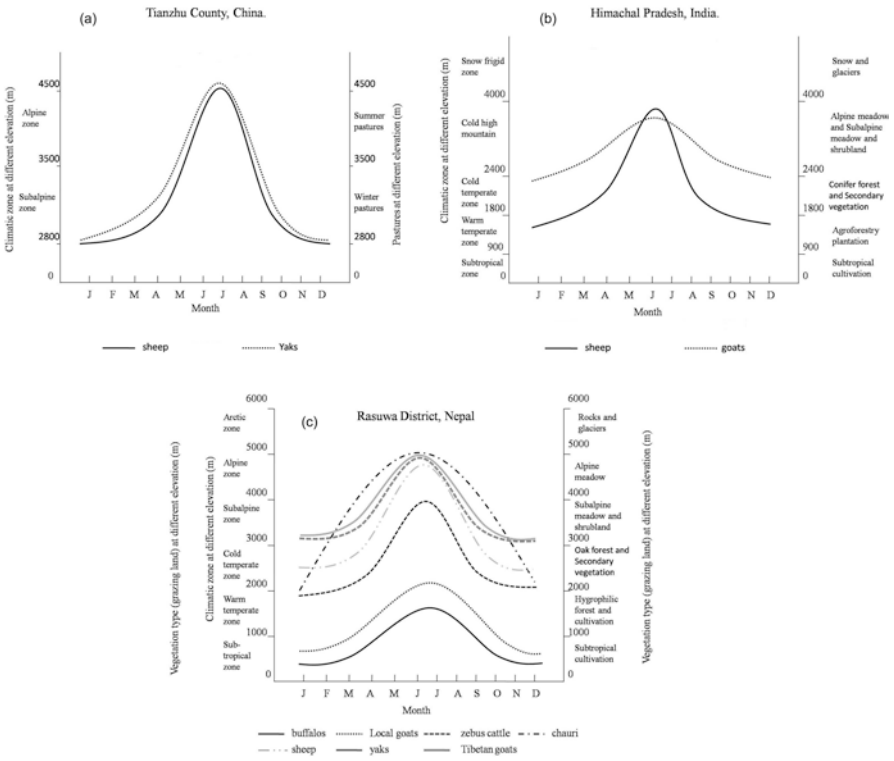


**Fig. 5.8** Indigenous grazing practices on the grasslands of Himalayan region

### 5.3.4.2 Indigenous Grassland Improvement and Protection Practices

There are commonly few interventions applied for improving the grasslands in indigenous management systems across the Himalayan region although the local pastoralists' protection actions are different in different sites due to grassland tenure, communal for both Nepal and India, and individual for China (Table 5.7). The survey results indicate that local pastoralists in the Himalayan region traditionally leave animal manure on the grazing pastures as a fertilizer with conventional notion of "nutrients cycling" between plants an animals, while no additional chemicals or organic fertilizers are applied to improve soil fertility and plant productivity. The survey results indicate that the local pastoralists in Nepal and India's Himalayas do not take any measures to control pests, rodents, and poisonous and weedy plants on grasslands, and epidemic diseases in plants and animals sometime cause high mortality rates in grazing livestock or major declines in pastoral production. However, the pastoralists in China's QTP take some actions supported by the government to control the rodents on the grasslands. Although irrigation systems are not applicable to local pastoral production systems in all

**Table 5.7** Indigenous grassland improvement and protection practices across three study sites

| Practices | Tianzhu County, China | Himachal Pradesh, India | Rasuwa District, Nepal |
|---|---|---|---|
| Actions | Individual (privatized pastures) | Collective (communal pastures) | Collective (communal pastures) |
| Fertilization | Animal manure | Animal manure | Animal manure |
| Irrigation | No | No | No |
| Weeds control | No | No | No |
| Pest control | Manually | No | No |
| Epidemic disease control | No | No | No |
| Campsite protection | Reseeding | No | Sometimes reseeding |
| Grassland degradation mitigation | Rotational grazing, fencing, reseeding | Rotational grazing, frequent movement | Rotational grazing, herd separation |
| Winter forage cultivation | Yes | Mostly no | Mostly no |
| Problems in forage cultivation | Lack of budget | No skill, no budget | No skill, no budget |
| Non-timber collection | Mostly yes | Mostly no | Mostly no |
| Influence of non-timber collection | Reducing forage resources | No | No |
| Measures to control non-timber collection | Tax, government control | Community regulations | Community regulations |
| Wildlife-livestock competitions | No | Yes | Yes |
| Wildlife habitat protection | Religion-based | Household-based | Community-based |
| Grassland eco-tourism | No | No | Yes |
| Influence of grassland eco-tourism | No | No | Improve livelihood, degraded grassland |

three case sites, most respondents in the survey believe that rainwater-fed strategies can maintain the systems quite well. Majority of pastoralists interviewees in Nepal and India's Himalayas recognize that the grassland degradation is a threat to their livelihood though they have no way to mitigate it due to skill and fund shortages. On the contrary, the pastoralists in China' QTP restore the degraded grassland through reseeding, fencing, and other interventions (Fig. 5.9).

Migratory and rotational grazing is not only a reasonable way to secure the feed availability, but also a good strategy to mitigate the grassland degradation. In Himachal Pradesh of India and Rasuwa District of Nepal, the local pastoralists have adopted their own arrangements for regulating access to shared grassland resources among the users' groups over a long history (Table 5.7). The length of time and number of livestock using the shared pastures are strictly controlled by local pastoralists' committees, and the stocking rates on the pasturelands are normally adjusted by the pastoralists themselves according to the grassland carrying capacity estimated by the experienced herders on the basis of sward height and cover. The pastoralists

**Fig. 5.9** Grassland fencing for restoration in China's Himalayan region, Qinghai-Tibetan Plateau (photo by Shikui Dong)

herd different pastoral livestock such as sheep and goat separately and rotationally to balance the utilization of different grazing sites and to promote the regrowth of grazed grasses. Although the forage cultivation for hay production is not common, the local pastoralist communities have managed and harvested dominant forage grasses for centuries. In Tianzhu County of China, the pastoralists followed the same arrangements for regulating the access to communal grassland resources before 1980s, when the use rights of grassland resources were privatized to individual households under the facilitation of Household Responsibility Policy in China, which allowed the individual household to contract the use rights of grassland with the government for over 50 years. Since late 1980s, the individual pastoralist household began to fence their pasturelands with the financial help from the government, which resulted in the erosion of traditionally collective use of shared grassland resources. However, the local pastoralists have developed the rotational grazing systems by moving the livestock from one fenced pasture into another one in a seasonal round, in addition to mobile grazing over different seasons. The local pastoralists normally use the fence to ban the grazing for grassland restoration when they find the degradation of grasslands due to overgrazing. Unlike the pastoralists in Himachal Pradesh of India and Rasuwa District of Nepal, the pastoralists in Tianzhu County of China usually cultivate some oat for hay as winter supplements around their settlement. In such a way, they can protect their grasslands by reducing the grazing pressures on winter pastures, which are easily degraded under intensive grazing.

In Himachal Pradesh of India and Rasuwa District of Nepal, harvest and collection of medicinal and aromatic plants on the grasslands are strictly controlled by the community committee through regulation to avoid the risk of grassland degradation and soil erosion. Local pastoralists are allowed to extract small quantities of such plants from the grasslands for personal use and as a minor family income source,

while harvest and collection of medicinal and aromatic plants for largely commercial use are prohibited by the community regulation. As claimed by most interviewees of the pastoralists in these two sites, the indigenous norms and regulations for controlling the massive harvest and collection of non-timber plants can help sustain their grassland resources and grazing practices. On the contrary, excavation of these organisms, especially the valuable ones such as Caterpillar Fungi (called "*Dong Chong Xia Cao*" in Chinese, which means "Worm in Winter and Grass in Summer") are free for the grassland owner (contractor) and possible for the outsider by paying a high tax. According to both interviewees of the pastoralists and some professionals, the overexploitation of the non-timber plants, especially Caterpillar Fungi have somewhat resulted in grassland degradation on the QTP of China.

In addition to protecting the grassland resources for livestock grazing, the pastoralists in Rasuwa District of Nepal protect the grassland habitats for wild herbivores through either committee-based regulations, in which a wildlife protection subcommittee is primarily responsible for monitoring wildlife habitats and guarding the illegal wildlife poaching and hunting. In Himachal Pradesh of India, the grassland wildlife habitat protection is exercised through household-based protection practice, in which individual households leave some grazing sites for wildlife and keep dogs to guard grazing livestock from injury by wildlife, so as to keep a balance in competition between livestock and wildlife. In Tianzhu County of China, few interviewees of the pastoralists claimed the conflicts between livestock and wildlife grassland grazing, as fence may block the wildlife outside their grazing pastures. Some interviewees reported that the scared sites and religious places are open for wildlife grazing and over there the wildlife killing and poaching are strictly prohibited by the religious groups and local community.

#### 5.3.4.3 Challenges and Problems in Grassland Management

According to the field surveys, the local pastoralists in all three case sites have similar feelings about the climate change (Table 5.8). In Tianzhu County of China, most respondents of local pastoralists claimed that the climate is becoming warm, with an overall trend of increasing hotness in prolonged summer and rising coldness in shortened winter. In both Himachal Pradesh of India and Rasuwa District of Nepal, most respondents of the local pastoralists stated the winter is becoming warmer and the summer becoming hotter. In Tianzhu County of China, the respondents of pastoralists generally stated that there is less snowfall in winter–spring and less rainfall in summer–autumn. In both Himachal Pradesh of India and Rasuwa District of Nepal, most respondents of the pastoralists claimed that they normally observe less snowfall in winter and retreat of glaciers year by year. As a result of declined precipitation, the plant production and cover on the grasslands are decreasing dramatically. The retreat of the glaciers has resulted in the decreased water flows in the most rivers, causing the problems of drinking water shortage in pastoral areas. In addition to drought, there are sometimes other climatic disasters such as snowstorms in Tianzhu County of China, and floods Himachal Pradesh of India and Rasuwa

**Table 5.8** Indigenous grassland improvement and protection practices across three study sites

| Practices | Tianzhu County, China | Himachal Pradesh, India | Rasuwa District, Nepal |
|---|---|---|---|
| Environmental challenges | | | |
| Warming | Yes | Yes | Yes |
| Drought | Yes | Yes | Yes |
| Floods | No | Sometimes | Some times |
| Snow disaster | Sometimes | No | No |
| Weeds invasion | No | Yes | Yes |
| Rodent burrows | Yes | No | No |
| Land degradation | Yes | Yes | Yes |
| Socioeconomic pressures | | | |
| Outmigration | Yes | Yes | Yes |
| Urbanization | Yes | No | No |
| Poor or unstable marketing | Yes | Yes | Yes |
| Social conflicts | Sometimes | Yes | Yes |
| Conservation projects | No | Yes | Yes |
| Development projects | Yes | Sometimes | No |
| Mining | Yes | No | No |
| Tourism | Sometimes | Sometimes | Yes |
| Impacts on pastoral systems | | | |
| Decline of forage production | Yes | Yes | Yes |
| Loss of edible grass species | Yes | Mostly yes | Mostly yes |
| Shortage of drinking water | Yes | Sometimes | Sometimes |
| Decline of livestock production | Yes | Yes | Yes |
| Increase of livestock mortality | Yes | Mostly yes | Mostly yes |
| Shortage of pastoral labor | Yes | Yes | Yes |
| Decline of household income | No (government subsidies) | Yes | Yes |
| Decline of social stability | Moderately yes | Moderately yes | Moderately yes |

District of Nepal, which may result in loss of grazing livestock (Table 5.8). The associated problems with climate change as well as social–economic changes such as weeds invasion in Himachal Pradesh of India and Rasuwa District of Nepal, pest outbreaks in Tianzhu County of China, and land degradation in all three case sites have also deteriorated grassland production and quality (Table 5.8).

Paralleled with the environmental challenges, socioeconomic pressures such as outmigration of young generations in Tianzhu County of China and Himachal Pradesh of India to big cities, and those in Rasuwa District of Nepal to overseas for well-paid labors, urbanization of remote areas in Tianzhu County of China, poor or unstable marketing in all three case sites have resulted the problems of labor shortage and livelihood decline among the pastoralist communities, threatening the grassland-based pastoralism in these areas. Rising conflicts between livestock grazers and agroforestry farmers or community forestry owners for sharing lowland forestry pastures in Himachal Pradesh of India and Rasuwa District of Nepal,

between different pastoralist households for sharing water resources and communal grazing passages in Tianzhu County of China have also caused social tensions in pastoral communities depending on the grasslands for their livelihoods. Growing government interventions such as conservation projects (at both regional and local levels) in Himachal Pradesh of India and Rasuwa District of Nepal, development projects (at both regional and local levels) in Tianzhu County of China have partially changed the grassland use from grazing to others, resulting in some decline of grassland production in these areas. Increasing public or private activities such as tourism in Rasuwa District of Nepal and mining in Tianzhu County of China have brought negative effects on the sustainable development of grassland production systems in these areas.

#### 5.3.4.4 Social Innovation for Sustainable Grassland Management

To mitigate environmental challenges and socioeconomic pressures, the local pastoralists have developed adaptive strategies through social innovations. Adjustment of grazing practice and grassland management is one of such adaptions, which are derived from evolving traditions of pastoral communities with environmental and social–economic changes. In Tianzhu County of China, earlier grazing on summer pastures at the high elevation and later grazing on winter pastures at the low elevation is an innovative way to mitigate the problems of drinking water shortage and forage production reduction associated with climatic warming and dryness at low elevation areas, and to simultaneously reduce the risk of winter pasture degradation through employing prolonged grazing time with higher livestock densities on summer pasture and shortened grazing time with lower livestock densities on winter pastures. In Himachal Pradesh of India, the local pastoralists have raised more goats than the sheep to control the spread of Crofton weeds at middle hill areas as the goats perform much better than sheep in browsing and digesting this invasive plant. In all three case sites, numerous pastoralist respondents claimed that they have strived to avoid the problem of grassland degradation through "frequent movement" and "mixed or complementary grazing of different livestock."

Collective action promoted by the well-developed local institutions is another way of adaptions employed by the pastoral groups in the Himalayan region, particularly in Nepal and India's Himalayas for sustainable grassland management in coping with the challenges from environmental changes and socioeconomic transformation. In Rasuwa District of Nepal, a committee of 11 to 12 people elected by the member households in the community acts as a leader and a decision-maker at community level. This community committee is responsible for making regulations of grazing management for whole community and mitigating conflicts arising over shared used of pastoral resources within the same herders' group or among different herders' groups through negotiation or community meeting, backed by various social norms and sanctions (Table 5.9). Under the community committee, some self-identified groups of households with common interests or having the same resource pools are composed of an association, e.g., yak association, sheep association.

**Table 5.9** Local institutions in grassland management

| Items | Components | Attributes |
|---|---|---|
| Grassroot institutions | | |
| Community level | Community Committee (*Panchayat*) | Elected body |
| Group level | *Al*-associations | Self-identified group |
| NGOs | Paldor Peak Youth Club (Nepal) | Voluntary organization |
| Decision-makers | Government officials or committee members | Community meeting |
| | Household representatives (mostly male) | Dialogue or negotiation |
| Guides for behaviors | Traditions or rules | Oral or documented |
| | Agreements | Mostly oral |
| Criteria for decisions | Policy and best implementation means | Formal |
| | Interests of members | Informal |
| Land tenure | Public/government (over 95 %) | Native grassland |
| | Private (less than 5 %) | Fodder filed |
| Sanctions | Authority coercion | External |
| | Social pressure | Internal |

Sometimes, a subcommittee of 5–7 people is elected from same type of associations to act as a representative to cooperate with other associations or to mitigate the conflicts existing within or outside the association. Both the community committee and the association can promote the collective actions of livestock grazing and feed harvest through enforcing the primary rules and regulations regarding when and how long the livestock are grazed on certain pastures, and when and where grass may be harvested as the hay for winter feed, so as to mitigate the threats and challenges associated with environmental changes and socioeconomic transformation. In Himachal Pradesh of India, the community committee called *Panchayat* and the household groups called *Pradhan* take the similar actions in Rasuwa District of Nepal to promote the collection actions of pastoral societies at the community level and the group level to cope with environmental challenges and socioeconomic pressures. We found from the previous study that these grass-root institutions work much better in social content and functions than the external administrative and political organizations in sustaining pastoral resource management (Dong et al. 2009).

Good partnership and network set among different stakeholders, pastoralists, researchers, extension agents, and government officials through social networks or political partnerships is a good adaptation to promote local innovations in political, technological, and social dimensions for sustainable grassland management in China's Himalayan region (Fig. 5.10). The survey in Tianzhu County of China show that the government fund the central or local extension agencies (such as Grassland Station) to work closely with local pastoralist community to monitor and identify the real-world problems in grassland management, which can be reported to the professionals in research institutions and universities. The researchers in professional organizations get financial supports to study the solutions to the identified real-world problems and work closely with local extension agents and government officials to translate their research findings into pastoralist' practices. The pastoral-

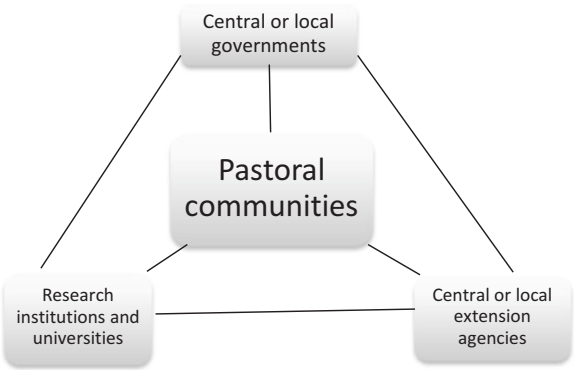


**Fig. 5.10** Cooperation governments, research bodies, extension agencies, and pastoral communities

ists can get some findings from the government to join the collaborative projects and to build their capacities (skills, knowledge, facilities, etc.) to mitigate these problems. From our on-the-ground observations on a pilot project of rodent control and reseeding degraded grasslands, it is clear that the grassland conditions have been greatly improved through multiple partnerships and collaborations among pastoralists, researchers, extension agents, and governments.

## 5.4 Conclusion and Implication

All these three cases show that local pastoralists in the Himalayan region have developed adaptive grassland management strategies based on their traditional practices and institutional arrangements to cope with environmental challenges and socioeconomic pressures. Although indigenous grassland management systems adopted by local pastoralists may have some weaknesses, it needs to be emphasized that no other systems can utilize the physical, climatic, and vegetative variations inherent in the Himalayas that effectively (Tamang 1993; Wu et al. 2015). The reason is that the local users have extensive knowledge about the exact local conditions and history of natural resource use (Tamang 1993), and the existence of indigenous natural resource management systems related directly to the difficulties that people face in obtaining resources (Gilmour 1990). In addition, the importance of local institutions of collective action needs to be highlighted for sustainable grassland management as stated by previous researchers in natural resource management studies worldwide (Chapagain 1986; Gilmour 1990; Gadgil et al. 1993; Gill 1993; Rai and Thapa 1993; Farooquee and Saxena 1994; Wu 1997; Chan 2002; Farooquee et al. 2004; Tesfay and Tafere 2004; Cai et al. 2013; Wu et al. 2015). It is commonly agreed that local institutional arrangements including customs and social conventions designed to induce cooperative solutions can overcome the collective action problems and help achieve efficiency in the sustainable use of natural resources (Gibbs and Bromley 1989; Ostrom 1990). This is extremely true from all these three cases across the Himalayan region.

In the context of environmental changes and socioeconomic transformations, adaptation is not simply a matter of designing projects or putting together lists of measures to reduce the impacts of climate change. A national policy response to these environmental and socioeconomic dynamics should be anchored in individual country's framework for sustainable grassland management. National governments bear the responsibility to develop and implement integrated policies and programs that build the resilience and reduce the vulnerability of their populations and emphasize preventive local actions (El-Ashry 2009). Although local pastoral societies in the Himalayan region are ready for adapting to the environmental changes and socioeconomic transformations, these autonomous adaptations require an enabling policy environment due to the complexity of these changes and transformations. The findings from these three cases suggested the possible ways in which the adaptation policy environment can be supportive of local responses:

- Adaptation planning should give greater attention to the development of effective institutional arrangements to support adaptation. This will require assessing the institutional systems essential to the development of adaptive capacity; the interfaces between the institutions within these systems; and the factors that make these interfaces more effective in delivering adaptive capacity.
- The institutional arrangements should address the overlapping roles and responsibilities of each sectoral government agency, NGOs, and community-based organizations operating at different levels. Defining the working relationship among government institutions, NGOs, and local communities will help translating the local practices into policy-making.
- Local, national, and regional adaptation planning needs to identify institutions acquiring and analyzing data and disseminating information that can contribute to adaptive capacity. Data and information sharing mechanisms needs to be designed and operationalized, so that delivery institutions can access reliable climate data and information when designing adaptation interventions.
- It needs to engage the public through participatory methods in order to respond to local needs, and create synergies between public and private/formal and informal adaptation interventions. To enable these activities, there is a need to establish a working arrangement at the local level among government agencies, NGOs, and local herders' communities engaged in implementing adaptation practices.
- The public sector and sponsors should be aware of the adaptation strategies that people are pursuing and align their support with these strategies. Information on these community level responses must be collected, documented, and disseminated for adaptation.
- An effective mechanism for the disbursement and use of financial resources at the community level needs to be designed using a participatory approach. The mechanism should prevent undue pressure and protect against the misuse of funds.
- It is necessary to develop confidence among people engaged in adaptation, e.g., introducing livestock and forage insurance schemes and support for storage and transportation.

**Acknowledgments** The author acknowledge the funding organizations including Ministry of Science and Technology of the People's Republic of China (Grant no. 2016YFC0501906), National Natural Science Foundation of China, and Asian Scholar Foundation, India China Institute of New School, Beijing Normal University for their financial supports. The author is grateful to the scholars whose articles, tables, and figures are cited in this chapter. The author is most grateful to the farmers/herders, practitioners, and professionals for their cooperation and efforts during my interview.

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# Chapter 6
# Himalayan Biodiversity: Trans-boundary Conservation Institution and Governance

**Shikui Dong, Nakul Chettri, and Eklabya Sharma**

**Abstract** Himalayan region is a trans-boundary area with rich biodiversity of global importance, while this region has been subject to great human stress and continues to face multiple threats with the global change. Inadequacy of the institutional arrangements and shortcomings of governance practice are challenging the effective conservation of trans-boundary biodiversity in this region. This chapter synthesizes an empirical overview of trans-boundary cooperation in establishing institutions for biodiversity conservation through case study in bordering areas across India, China, Nepal and Bhutan. Based on the hypothesis that trans-boundary biodiversity protection involves understanding tightly coupled interrelationships between natural systems and human society, a theoretic institution framework of sixfold matrix including economic, technical, social, environmental, ethnical/cultural, and political dimensions was structured to promote the efficient trans-boundary biodiversity conservation in the Himalayan region. It was proposed in this chapter that regional institutions, in close collaboration with national governments of member countries, needed to develop a vision for an integrated approach to institutionalize the trans-boundary biodiversity conservation.

**Keywords** Convention on biodiversity • Himalayan biodiversity • Kangchenjunga landscape • Regional cooperation framework • Trans-boundary biodiversity conservation • Sixfold matrix of biodiversity conservation governance

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S. Dong et al. (eds.), *Environmental Sustainability from the Himalayas to the Oceans*, DOI 10.1007/978-3-319-44037-8_6

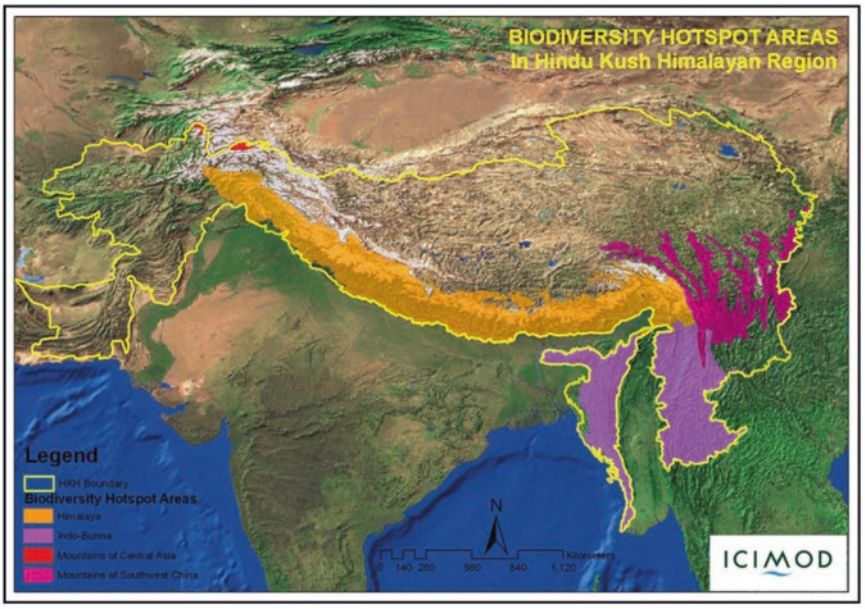


**Fig. 6.1** Biodiversity hotspot in Hindu Kush Himalayan region (adopted from Sharma 2008)

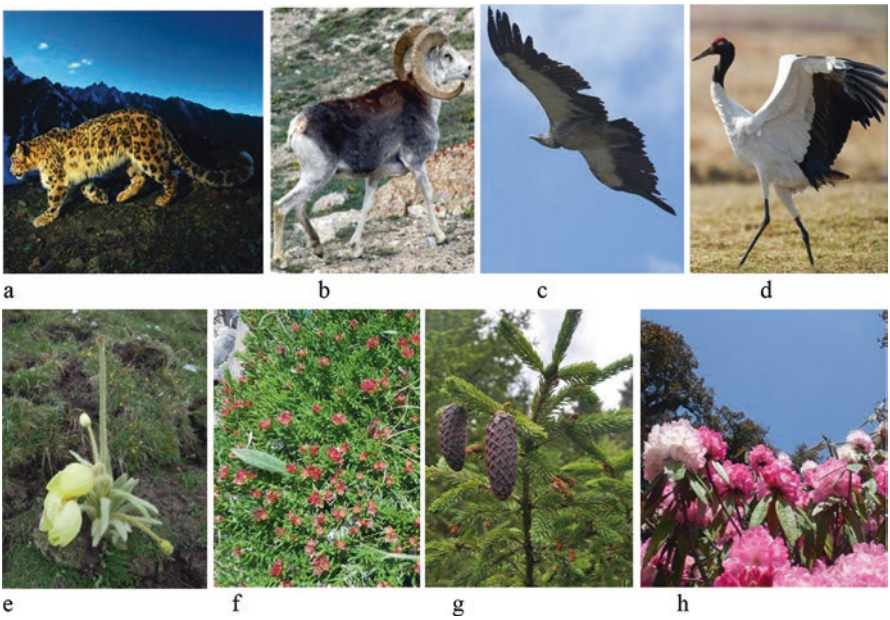


**Fig. 6.2** Representative key animal and plant species in HKH region (photos taken by Wu Xiaoyu, Ma Ming, and Zhangxiang): (**a**) snow leopard (*Uncia uncia*); (**b**) blue sheep (*Pseudois nayaur*); (**c**) Himalayan griffon (*Gyps himalayensis*); (**d**) black-necked crane (*Grus nigricollis*); (**e**) yellow Chinese poppy (*Meconopsis integrifolia*); (**f**) Himalayan rhodiola (*Rhodiola himalayensis*); (**g**) Tibetan juniper (*Sabina tibetica*); (**h**) Nepali rhododendron (*Rhododendron cowanianum*)

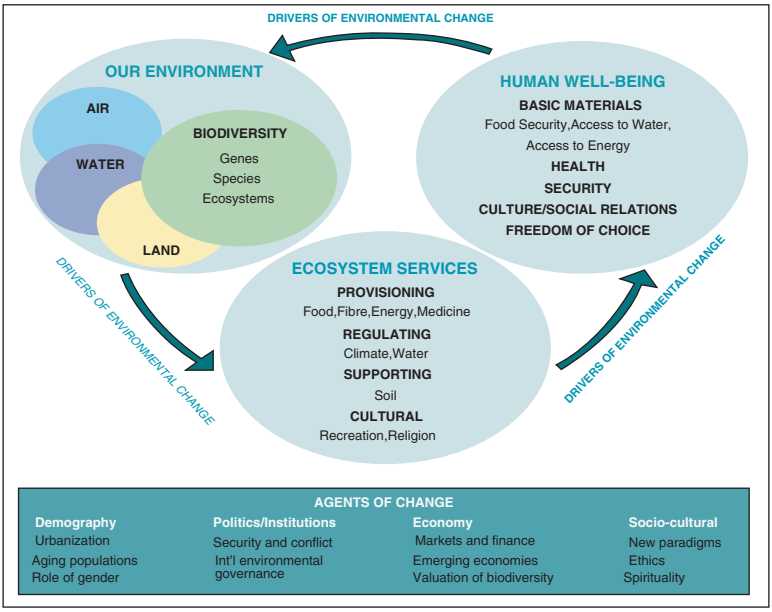


**Fig. 6.3** Dynamics and interactions of biodiversity, ecosystem services, and human well-being (adopted from McNeely and Mainka 2009)

## 6.1 Introduction

Himalayan or broadly Hindu Kush-Himalaya (HKH) region is a trans-boundary realm with rich biodiversity of global importance, endowed with a rich variety of genes, species, and ecosystems of global importance (Myers et al. 2000). This remarkable landscape covers four out of 34 global biodiversity hotspots (Fig. 6.1), which are key habitats for endangered or endemic plant species such as Snow leopard (Fig. 6.2). There are 6 UNESCO Natural World Heritage Sites, 60 eco-region types (including 30 critical eco-regions and 12 Global 200 eco-regions), 30 Ramsar sites, 488 protected areas, 330 Important Bird Areas, and 53 Important Plant Areas for medicinal plants (ICIMOD 2009). According to a report from International Centre for Integrated Mountain Development (ICIMOD) in 2009, the HKH region sustains about 150 million people and provides the habitats for 25,000 species of angiosperms (10 % of the global total), 75,000 species of insects (10 % of the global total), 1200 bird species (13 % of the global total), and the wild relatives of many modern-day crops.

Biodiversity in the Himalayan region, according to Sharma and Acharya (2004), provides ecological services in many forms—soil, water, and nutrient conservation (watershed protection), abatement and filtration of water and air pollutants, flood control, positive impacts on climate change, carbon sequestration, and so on (Fig. 6.3). Meanwhile, the rich biodiversity is the foundation, which underpins social, economic, and cultural diversity in Himalayan region (Chettri and Sharma

2006). Sustainable use and conservation of biodiversity in Himalayas can make meaningful contributions to the health and welfare of about 150 million living in this region and has an impact on the lives of three times as many people living in the downstream regions (Chettri and Sharma 2006; Schild 2008).

Despite the ecological and social importance of the biodiversity, this region has been subjected to great human stress and continues to face multiple threats with the global change (Ives et al. 2004; ICIMOD 2009). The pressures are mainly from forest resources extraction, land use change, poaching, mining, unregulated tourism, and other market forces, as well as global warming associated with human destruction (Sherpa et al. 2003; Chettri and Sharma 2006). If the environmental degradation induced by human disturbance in this region continues unabated, much of the region's biodiversity would be lost in near future (Menon et al. 2001; MEA 2005; Chettri and Sharma 2006). Although many national parks or nature reserves have been set to protect the biodiversity in this region, the majority of the protected areas which are trans-boundary in nature are isolated as conservation 'islands' (Sherpa et al. 2003; Ives et al. 2004; Sharma and Chettri 2005). Political will has proved to be a formidable constraint owing to the perception that joint conservation efforts might threaten national sovereignty (Wikramanayake et al. 2001). The trans-boundary challenges in biodiversity conservation highlight the need for decision-making processes that go beyond the borders of individual nation-states within the Himalayan region.

Although many voices have call for better trans-boundary coordination and management of environments in the Himalayan region, the evidences demonstrate that regional institution in Himalayan region is still not sufficiently robust to address trans-boundary environmental challenges effectively (Sherpa et al. 2003; Dong et al. 2010). In sum, two sets of gaps have emerged from the analysis of the trans-boundary environmental challenges and the regional institutional response in Himalayan region. The first set is directed to the inadequacy of the structural arrangements that characterize the institutions, e.g., lack of channels for direct communication among the full range of stakeholders, local communities, local governments, and national governments (Sharma and Chettri 2005). The second set highlights the opportunities to overcome the shortcomings of governance practice, requiring shifts in the ways in which national governments and regional institutions interact with the general public (Sharma et al. 2010). These two gaps are critical to the creation of an enhanced regime of regional environmental institution that meets the challenges in trans-boundary biodiversity protection, as the institutions in principle can overcome evident obstacles when there are the gaps between theory and reality in trans-boundary biodiversity protection (Van Schoik et al. 2004). From this context, this study was conducted to gain an empirical overview of trans-boundary cooperation in establishing institutions for biodiversity conservation through a literature review, a comprehensive case study, and a series of semi-structured, open-ended, in-depth interviews. On the basis of the hypotheses that issues of trans-boundary biodiversity protection involve understanding tightly coupled interrelationships between natural systems and human society, which cannot be well-understood or effectively managed within a single dimension, the empirical analysis was guided by a theoretic institution framework of six-fold matrix including economic, technical, social, environmental, ethnical/cultural, and political dimensions.

## 6.2 Case Studies on Trans-boundary Biodiversity Conservation in Himalayan Region

### *6.2.1 Research Methology*

#### 6.2.1.1 Literature Review

Through collecting and reviewing research papers, reports, and documents via different media, we obtained the following information: (1) effective tans-boundary biodiversity conservation institutions in other regions of the world; (2) feasible approaches and possible channels to improve trans-boundary institutions in biodiversity conservation derived from the worldwide successful cases. Supplemental information obtained from interviewing the professionals and practitioners was used to crosscheck the information and data collected from the secondary sources.

#### 6.2.1.2 Case Analysis

Through analyzing the information and data from a case study in Mt. Kangchenjunga conducted for more than 5 years, the expected outcomes were obtained in the following perspectives: (1) the effectiveness and values of institutional development in trans-boundary biodiversity conservation; (2) institutional problems existing in trans-boundary biodiversity conservation practices; (3) strategies for improving the trans-boundary biodiversity conservation institution.

### *6.2.2 Case Study Results*

#### 6.2.2.1 Regional Cooperation Framework in Kangchenjunga Landscape

The Kangchenjunga complex, shared by Bhutan, China, India, and Nepal, is an important trans-boundary landscape (CEPF 2005). The extreme topographic relief of the world's third highest mountain constrains the dispersal of plant and animal species and affects microclimatic conditions. The designation of 30 % of the southern part of the area as protected area network with an additional 11 % as proposed corridors makes the landscape an important biodiversity repository (Chettri et al. 2008). Moreover, the landscape connects the Bhutan Biological Conservation Complex (Sherpa et al. 2003) with the Sacred Himalayan Landscape (GoN/MoFSC 2005), forming an important corridor in the eastern Himalayas. Thus, this landscape is an important trans-boundary complex for biodiversity conservation, which can connect different key habitats of important species through ecological corridors (Fig. 6.4). In spite of its significance, the Kangchenjunga landscape faces numerous threats to its biological and other diversity as a result of habitat transformation and fragmentation, unsustainable extraction and use of natural resources, impacts from

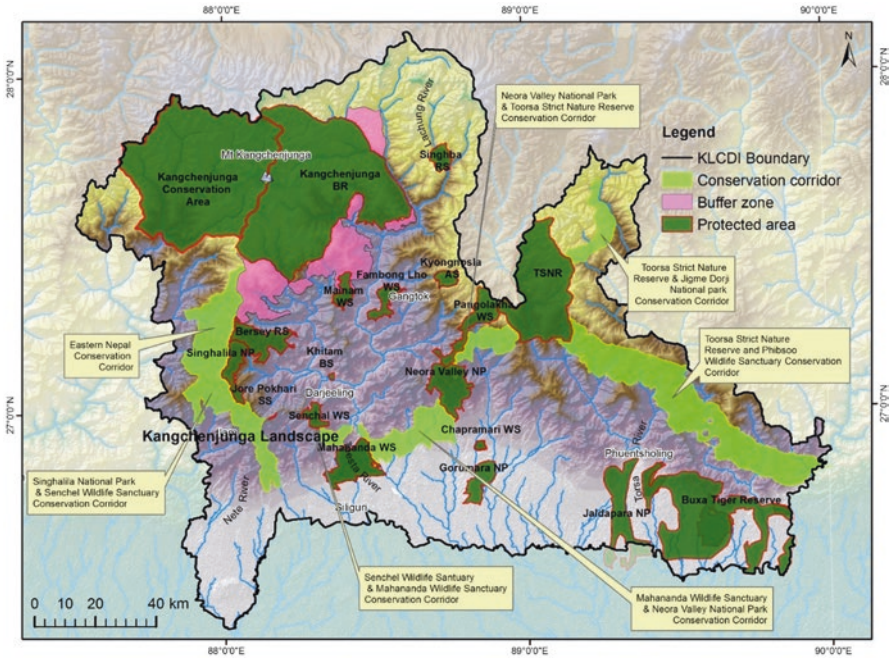


**Fig. 6.4** Ecological corridors for trans-boundary biodiversity conservation in Kanchenjunga landscape (adopted from ICIMOD 2016)

unregulated tourism, and others. Some 65 plant, 19 mammal, and 11 bird species are already threatened in this region (Chettri 2000). In this case, a trans-boundary landscape approach has been developed by global mountain community during the last 8 years, aiming at establishing a landscape that could sustain diverse ecosystem processes and services.

The Regional Cooperation Framework (RCF), one of the outcomes from the landscape approach, has provided the guidance to better the cross-nation management of trans-boundary biodiversity conservation in this area (Sharma et al. 2007). The RCF proposed by the scholars in ICIMOD is based on the six principles: participatory management—ensuring participation of indigenous and local communities, as well as disadvantaged and socially marginalized groups, for biodiversity conservation and management; equitability—ensuring fair and equitable sharing of benefits arising from genetic and biodiversity resources; partnerships—building partnerships among local communities, government/non-government institutions, the corporate sector, and financial institutions; ecosystem approach—taking an integrated approach into consideration for socioeconomic, cultural, and environmental security; lessons-learned approach—applying lessons learned from other trans-boundary mountain programs including the Alpine Convention, the Carpathian Convention, and the Mount Everest trans-boundary program; trans-boundary Cooperation—promoting and strengthening trans-boundary cooperation (Sharma et al. 2007).

**Table 6.1** Parties to convention on biological diversity within the Kangchenjunga landscape

| Country | Signed | Party | Focal institution |
|---|---|---|---|
| Bhutan | 11 Jun. 1992 | 5 Aug. 1995 (ratification) | National Environment Commission |
| China | 11 Jun. 1992 | 5 Jan. 1993 | State Environmental Protection Agency |
| India | 05 Jun. 1992 | 18 Feb. 1994 (ratification) | Ministry of Environment and Forests |
| Nepal | 12 Jun. 1992 | 23 Nov. 1993 (ratification) | Ministry of Forests and Soil Conservation |

The RCF includes four constitutive elements: trans-boundary biodiversity conservation; scientific and technical cooperation; information exchange and sharing; and regional guidelines and soft legal instruments. The Framework presents minimum standards and indicators that can be applied to evaluate a country's progress towards achieving Convention on Biodiversity (CBD) goals within the Kangchenjunga landscape (Table 6.1). Moreover, the Framework reflects the national biodiversity strategies and action plans of each of the three countries in the Kangchenjunga landscape, i.e. Bhutan, India and Nepal, aiming to bring together policy-makers on a common platform for trans-boundary biodiversity cooperation; to share national updates with respect to the CBD implementation; to identify policy issues related to trans-boundary cooperation; to develop a policy framework for cooperation; and to foster partnerships at the regional level. According to Sharma et al. (2007), the RCF was conceived as a tool to help address the root causes of biodiversity loss in the landscape; encourage fast-track planning and implementation of programs; and enhance complementarities and coordination between and among diverse actors engaged in biodiversity conservation in the Kangchenjunga landscape.

Achieving the objectives of the RCF has many implications in governance mechanisms and processes for coordinating the activities of multiple stakeholders at local and national, and regional and international levels. Firstly, it can help to recognize and strengthen local capacity efforts for community-based trans-boundary biodiversity conservation and sustainable development and enhance the resilience of coupled human and natural systems within the Kangchenjunga landscape. Secondly, it can promote the collection of biodiversity conservation data across the political boundary of Kangchenjunga landscape and facilitate coordination among the various actors and stakeholders within the Kangchenjunga landscape through enhancing trans-boundary collaboration in biodiversity monitoring and information exchange networks. Thirdly, it can help to build a common platform for trans-boundary biodiversity cooperation and enhance cooperation among the regional member countries through establishment of a Regional Cooperation Framework. Fourthly, it can foster partnerships for community organizations and self-help groups, religious institutions, local government, state government, non-government organizations, research institutions, education institutions, and ministries/departments at the regional level. Lastly, it can provide a model and example for developing Regional Cooperation Framework of trans-boundary biodiversity conservation for the whole Himalayan region, e.g. Mount. Kailash and other mountainous areas worldwide.

Although the scholars in ICIMOD have structured a possible RCF for trans-boundary biodiversity conservation in the Kangchenjunga landscape, there were some flaws in six-fold matrixes (technical, social, cultural/ethnical, economic, environmental, and political) of institutional frameworks in effectively implementing the RCF to bring benefits: (1) the RCF fell under the overall framework of the CBD (1998)—the major global agreement on the sustainable use and conservation of biological diversity, while China as a member country of CBD within the Kangchenjunga Landscape (Table 6.2) was not included for formulation of Kangchenjunga RCF; (2) a comprehensive information database needed to effectively develop intervention strategies and to adequately address trans-boundary issues including compensation for environmental services and upland-lowland linkages; (3) alternative livelihood options were limited and physical and financial constraints prevented networking the information-sharing systems and exchanging best practices among countries within the landscape; (4) varying legal and policy aspects affected resource use and conservation mechanisms (including community rights on the use and tenure of resources) differently in the countries within the landscape; (5) lack of regional administrative institutions responsible for facilitating and monitoring environmental protection initiatives was limiting fully effective implementation of the Kangchenjunga RCF strategies. As a result, the official implementation of this RCF remains in a long way ahead.

#### 6.2.2.2 Institutional Arrangement for Trans-boundary Biodiversity Conservation in Himalayan Region

By using the landscape approach to examine the history of human activities in a particular environment to both the natural world and the people living in the area, the researchers from ICIMOD have carried out a series of consultations, baseline surveys, and feasibility assessments on developing corridors and facilitating regional cooperation across broad landscapes in Himalayan region (Chettri and Sharma 2016). The newest trans-boundary landscape facilitated by ICIMOD for biodiversity conservation in HKH region is Hindu-kush Karakoram-Pamir landscape after Kailash landscape (Fig. 6.5). The lessons learned from these case studies indicate that trans-boundary biodiversity conservation is facing significant challenges. The structures of the institutions in Himalayan region were not sufficient in terms of mandate and capacities, location of authority at appropriate levels of decision-making, representation of national governments, and the integration of environmental concerns into operations. Therefore, institutional innovation and governance improvement are clearly high priorities for addressing the trans-boundary biodiversity conservation challenges in the Himalayan region. From the worldwide experience, we recognized that several trans-boundary conservation paradigms have provided the backdrop for institutional responses to these challenges, in which regional actors are playing increasingly important roles (Metcalfe 1999; Sandwith et al. 2001; Mayoral-Phillips 2002; Van Schoik et al. 2004; Jones 2006; Montini and

**Table 6.2** Institutional framework of trans-boundary biodiversity conservation

| Dimensions | Targets | Indicators |
|---|---|---|
| Technical | Promoting the protection of ecosystems, natural habitats, and maintenance of viable species in natural surroundings | Adoption of measures, and establishment and maintenance of facilities for and in-situ and ex-situ conservation |
| | | Adoption of measures for the recovery and rehabilitation of threatened species and for their reintroduction into their natural habits |
| Environmental | Promoting the protection of ecosystems, natural habitats, and the maintenance of viable species in natural surroundings along the cross-nation border | Reduction in illegal resource extraction and movement of wild species and their derivatives across the border |
| | | Movement of flagship species through trans-boundary conservation corridors |
| Social | Networking the cooperation between different bodies in developing methods for the sustainable use of biological resources, as well as encouraging equitable sharing of benefits arising from the utilization of such knowledge and practices | Increased public education, participation, and awareness regarding biodiversity conservation and sustainable resource use |
| | | Regular exchange of information among different bodies on biodiversity conservation and sustainable resource use; Increased access to equitable resources and sharing of resulting benefits by marginalized communities |
| Economic | Promoting environmentally sound and sustainable development in areas adjacent to protected areas | Increased sustained economic growth among communities in the landscape |
| | | Formation and implementation of development guidelines by appropriate authorities |
| Ethnical/cultural | Calling the recognition for preserving and maintaining indigenous knowledge and practices | Increased rates of adaptation of traditional use of biological resources that are compatible with conservation or sustainable use requirements |
| | | More respects for the rights of indigenous and local communities biodiversity conservation and sustainable resource use |
| Political | Developing the trans-boundary biodiversity conservation Institutions to protect threatened species, populations, and habitats within cross-nation border region | Standard policies in place at national and trans-boundary levels to address trans-boundary conservation issues |
| | | Regional institution in facilitating the development of the trans-boundary biodiversity conservation Framework |

Bogdanovic 2011). Out of these paradigms, we found that improvement of institutional arrangement, enhancement of the regional governance practice, encompassing transparency and the provision of information, public involvement, and implementation of accountability mechanisms are essential to better trans-boundary biodiversity conservation.

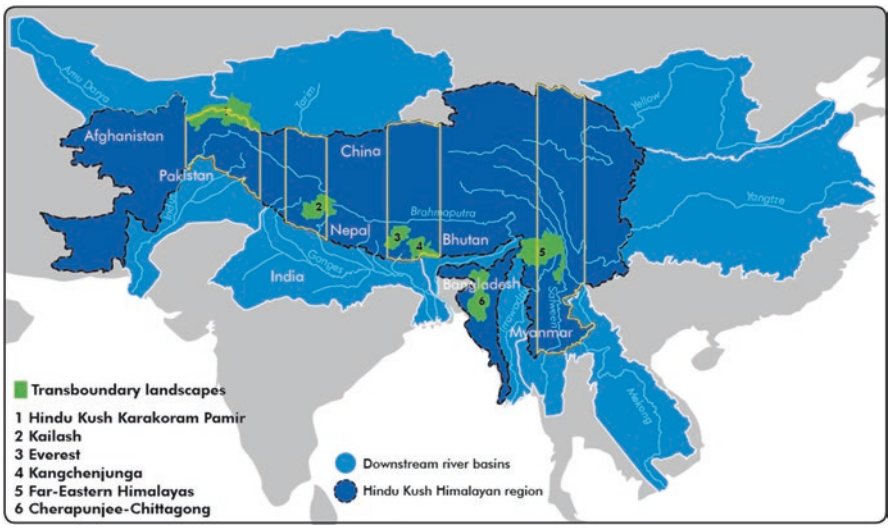


**Fig. 6.5** Trans-boundary landscapes and transects designed by ICIMOD for biodiversity conservation in Hindu Kush Himalayan region (drawing by Chettri and Sharma 2016)

The trans-boundary challenges highlight the need for decision-making processes that go beyond the borders of individual nation-states. They illustrate the necessity of creating institutional structures of trans-boundary biodiversity conservation designed to nurture ecologically sustainable and socially acceptable development that function on many levels. Institutional richness—a diverse range of institutions with overlapping and complementary mandates and with multiple channels of communication and accountability—will result in the more effective governance of trans-boundary issues (Lipschutz 1997). On the one hand, the roles of regional institutions are increasing as they begin to provide more effective channels for cooperation and collaboration among a number of stakeholders. On the other hand, national governments occupy a central position within almost all decision-making processes in Himalayan Region; their participation is needed for any viable long-term solution to the area's biodiversity conservation problems. Therefore, the mechanism should be established to comprise a decision making body, a technical support body, and a funding body. A decision making body, Regional Environmental Protection Agency, will be possibly hosted by the South Asia Association for Regional Cooperation (SAARC), an intergovernmental organization that is present in the HKH region since 1985 and deals by mandate with cooperation concerning agriculture and rural development, health and population activities, women, youth and children, environment and forestry, science and technology, human resources development, and transport. A technical support body could be regional research and development organizations

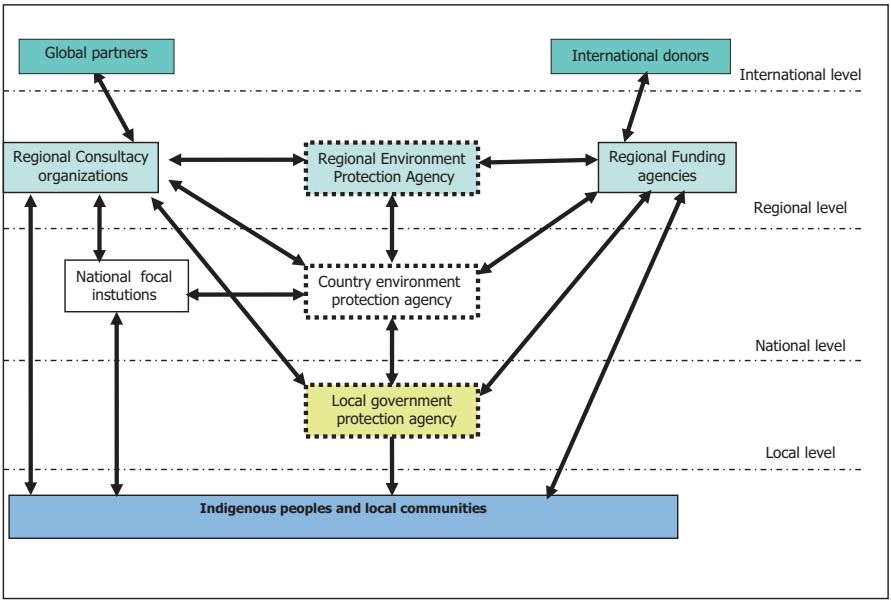


**Fig. 6.6** Structure of regional administrative institutions for trans-boundary biodiversity conservation

such as ICIMOD, which acts as a consultancy to provide the technical support for decision-making. A funding agency could be foundation or financial organization such as Asian Development Bank, which can provide the funding resources for implementing the trans-boundary cooperation framework. All these regional institutions work closely with international institutions, national governments, research institutions, education organizations, local government, and communities to form institutional network for implementation of regional trans-boundary cooperation framework (Fig. 6.6).

Under the structure of regional institutions for trans-boundary biodiversity conservation, the portfolios of multidisciplinary biodiversity strategies in Himalayan region can be shaped from technical, environmental, economic, social, ethnical/cultural, political dimensions to ensure good ecosystem services, socioeconomics and livelihood development, ethical knowledge sharing, trans-boundary cooperation, and policy formulation and implementation (Table 6.2). In the technical dimension, ICIMOD and other research institutions need to develop a holistic biodiversity conservation approach beyond biological corridor establishment to integrated ecosystem management, a new interdisciplinary model for biodiversity conservation proposed by CBD (2009), to protect multiple biodiversities of genes, species, ecosystem, and landscape diversities in the region. In the environmental dimension, the research community such as ICIMOD needs to valuate the importance of biodiversity conservation in environmental services such as fresh water supply, soil erosion control, clean air provision, and climate regulation and administrative body needs to

monitor the status of regional biodiversity and coordinate the payment for environment services of regional biodiversity from downstream receptors to upstream providers. In economic dimension, trans-boundary biodiversity conservation institutional practices need to be integrated into regional development strategies such as Western Development Program in China and to community development interventions such as poverty alleviation and livelihood improvement. In social dimension, local communities and interest groups could be more thoroughly integrated in the space for participation within the national and regional settings; public availability of information regarding the policies and procedures of their operations needs to be promoted by regional institutions. In ethnic/cultural dimension, wise traditional knowledge for sustainable natural resources use and strong ethics for biodiversity conservation among different indigenous communities need to be respected and integrated into the formulation and implementation of trans-boundary biodiversity conservation programs and policies. In political dimension, the regional institutions need to develop Cooperation Framework to discuss and formulate the trans-boundary biodiversity conservation policies and to promote more actively broad-based dialogue that fosters political commitment for enhanced national and sub-national biodiversity conservation practices. Furthermore, the regional institutions need to improve their efforts to provide the public with timely information on project plans while concurrently widening the channels for upward information flows regarding environmental, economic, and social outcomes from the grassroots level to national and regional levels. At the same time, the donors and civil society need to increase their efforts to promote the exchange of existing information, catalyze discussion with policymakers, and encourage the broader representation of society in the creation and use of that information.

## 6.3 Implications of Case Study

Tran-boundary biodiversity in Himalayan region provides ecological services for both upstream and downstream populations beyond the political boundaries of nations and states and across societies, religions, cultures, gender, and generations. However, drivers in demography, economy, politics, and socio-cultural aspects are presently changing Himalayas' environment, especially biodiversity, leading to reduced benefits of biodiversity for human well-beings in this region. These environmental problems cannot be addressed solely through technical innovations, political reformations, or economic development; sound policy formulations and management decisions are required to provide important insights into complex systems (Yang and Dong 2010).

In the trans-boundary area, distribution of biodiversity does not respect political borders because they might not be exactly ecological boundaries (Singh 1999). In Himalayan region, the territorial boundaries of sovereign states have not only artificially partitioned biodiversity, but also divided the political, social, economic, cultural, and ethnic links that existed between the environment and society. Therefore, trans-boundary biodiversity protection needs to be initiated in multiple dimensions,

which can integrate the social, economic, cultural, and political factors. So far, however, the conservation initiatives taken in this region are often ecologically oriented and ignore social, economic, and political driving forces. Moreover, the relationship between conservation and human needs has been overlooked (Nepal and Weber 1995; Chettri et al. 2002; Bawa et al. 2004). In this study, we developed an integrated framework for trans-boundary biodiversity conservation in Himalayan region. This framework can address the social, environmental, economic, cultural, ethnic, and political implications of trans-boundary biodiversity conservation in this region.

The environmental services provided by the Himalayas' biodiversity form the basis for the physical security of mountain people living in these areas and ensure the sustainability of their production systems into the future. Thus, the most pressing challenge in this region, similar to mountainous areas elsewhere, is to conserve biodiversity and at the same time improve the livelihoods of communities dependent on natural resources and biodiversity. Local people cannot be expected to abandon income from timber harvesting, pasture grazing, and medicinal plant collection for the sake of preserving the global existence or environmental values of biodiversity. The payment for biodiversity conservation is a possible solution to urge those making land-use decisions to conserve and not destroy it (Frost et al. 2006). The balance between conservation and development necessarily involves trade-offs (Lee et al. 2001; Tomich et al. 2001), and development that destroys the natural resource base and environmental service functions is unsound (Frost et al. 2006). Therefore, the framework of trans-boundary biodiversity institutions proposed in present study can facilitate dialogues among member countries to establish an agreed-upon set of basic environmental norms of cooperation that would provide a basis for dialogue and exchange among the member countries to gain win-win situation between the regional development and trans-boundary biodiversity conservation.

Local communities had longstanding traditions of conservation and restrained resource use guided by conservation ethics, customary laws, and traditional rights. There were age-old traditions of exchanging resources and expertise among the people in the region (Oli 2005). Such practices provide a strong organizing principle in how people relate to vast natural spaces and the biodiversity therein. Moreover, genetic diversity relating to local customary systems of natural resource management, including unique knowledge, skills, and institutions, can often be fully expressed only through local languages and related culture and traditions (Oli 2005). The traditional knowledge is an essential part of the bio-cultural diversity in the Himalayan region, where the term "bio-cultural" encompasses both biological resources and cultural features. The traditional natural resources management systems such as Dzumsa by the Pipon among the Lanchungpas in Sikkim (Rai et al. 1994), Na Zong Nyo as wise indigenous knowledge and sustainable natural resources use practices among the Lepchas (Jha 2002), and strong ethics for landscape level conservation among Sikkimese Buddhists (Ramakrishnan 1996) are some of the effective traditional conservation measures. However, these practices have been slowly eroded by different stressing factors, leading to numerous challenges in conserving biodiversity and natural resources (Murphy et al. 2005; Yonzon 2005). For example, robbing the indigenous communities of their resources in South Himalaya through a method of bio-piracy by TNCs show that ill-recognition of these communities' traditional

methods and practices led to the failures in sustainable natural resource and biodiversity management. Therefore, societal integrity of the different ethnic groups for biodiversity protection in the Himalayan region needs to be strengthened via an integrated approach, which can promote sustainable development at the scale of a culturally, ethnically, and biologically contiguous landscape.

If biodiversity conservation issues can be linked to a broader range of political and economic cooperation trends, it is possible that the benefits gained from environmental cooperation can be increased (Wolf 2001). The global experience provides good examples how the regional cooperation can work for facilitating the institutions of trans-boundary biodiversity conservation. They include two European agreements: the Alpine Convention and the Carpathian Convention. The Alpine Convention was signed in 1991 and ratified in 1999, covering an area of 191,000 $km^2$ and a population of 12 million people belonging to seven countries in Western Europe, as well as the European Union. The Carpathian Convention was adopted by the seven Carpathian countries in central and Eastern Europe in May 2003 and came into force in January 2006. Both focus on preservation and protection linked to balance and sustainable development. Although institutions in the Himalayan region are not yet up to the region's environmental challenges, increased political and economic cooperation has created a number of opportunities for bridging environmental institution gaps among member countries. Analysis of experience from other parts of the world suggests that, in the long term, a vibrant network of researchers—who share a common set of norms and work together to generate information and analysis—is critical to the implementation of institutional governance principles (Brunnee and Toope 1997; Haas 1992). Trans-boundary cooperation for research, adaptive management, and exchange of expertise and other resources has been promoted to strengthen and improve conservation and management of mountain biodiversity in Himalayan region (Rastogi et al. 1997; Sherpa et al. 2003; Sharma and Chettri 2005). Thus, there is strong political basis for developing the regional institutions of trans-boundary biodiversity conservation in the HKH region.

Here, we structured the institutional framework of biodiversity conservation for trans-boundary complex on the six-fold matrix, i.e., technical, environmental, social, economic, ethnical/cultural, and political dimensions. The whole framework shaped the portfolios of multidisciplinary biodiversity strategies, good ecosystem services for human well-beings, socioeconomics and livelihoods for a community-based conservation, ethical knowledge sharing for a holistic conservation network, trans-boundary cooperation for effective conservation, and policy development for implementation of regional and global conservation planning and measures.

## 6.4 Concluding Remarks

It can be concluded that conserving the trans-boundary biodiversity, preserving the related ecosystem functions, meeting the needs of the region's communities and sharing with them the benefits derived from the fair and equitable utilization of their

natural resources, genetic resources, and associated traditional knowledge are major intertwined challenges in the Himalayan region. Drawing government and regional institutions into research activities can enhance the credibility and legitimacy of alternative sources of information and analysis within official decision-making processes. Regional institutions, in close collaboration with national governments of member countries, need to develop a vision for an integrated approach to institutionalize the trans-boundary biodiversity conservation from technical, environmental, social, economic, ethnical/cultural, and political dimensions.

**Acknowledgments** The authors acknowledge the funding organizations including Ministry of Science and Technology of the People's Republic of China (Grant no. 2016YFC0501906), National Natural Science Foundation of China, and Asian Scholar Foundation, India, China Institute of New School, Beijing Normal University for their financial supports. The authors are grateful to the scholars whose articles, tables and figures are cited in this chapter. The authors are most grateful to the farmers/herders, practitioners, and professionals for their cooperation and efforts during my interview. The case study cited here is from the programme supported by ICIMOD's member countries, its core donors including German Development Cooperation - GIZ and Austrian Development Agency.

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# Chapter 7
# Environmental Grassroots Partnerships and Potential for Social Innovation

**Nidhi Srinivas**

**Abstract** This chapter reviews the concept of social innovation (SI) towards two sets of ecological questions: How can local management actions strengthen ecosystem response to crises? Through what organizational arrangements are ecosystem responses coordinated? The first part of this chapter reviews the concept of social innovation; the second part presents cases from southwest Rajasthan and west Yunnan on social innovation, based on fieldwork conducted in January and August 2011. The cases describe SIs that vary in scale and technology: beehives; improved wood burning stoves; pump sets; working groups to raise funds and share technology; working groups to clean shared water sources; community forest wardens; village councils for water sharing and commons access; and seed banks, land regeneration, child care, and night schools. However these cases can be read as not only demonstrating social innovation but also, in terms of critiques of the policies of neoliberal governments, and in terms of narrative ruptures, puzzles that reveal the push and pull of agential interests in the realm of ecology. The final part of the chapter argues for a focus on the politics of social innovation. As a term SI signifies the possibilities for shifting power structures through networked engagement. Networks including of NGOs must work with state governments to mobilize local people with their own interests. This requires a variety of groups, such as village councils, state-mandated bodies, registered NGOs, and networks, to negotiate and mobilize around ecological response.

**Keywords** Climate change • Deccan Development Society • Ecological management • Ecosystems • Environment degradation • Field study information

## 7.1 Introduction

The *Rashomon effect* (Heider 1988) takes its name from a well-known mid-1950s film of Akiro Kurosawa that reminds us there are different perspectives to a story. At times rather than asserting certitude or the "truth" or a scientific means of reaching

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S. Dong et al. (eds.), *Environmental Sustainability from the Himalayas to the Oceans*, DOI 10.1007/978-3-319-44037-8_7

it, equally valuable if not more, may be an approach that allows the sharing of different perspectives, in the hope of moving towards some sort of gradual resolution of the incompatible qualities of individual narratives. One area today where such a Rashomon effect seems apparent is the state of the environment itself. Does global warming exist? How should we narrate the story of the environment and human response in India and China? What are different perspectives, and what would recognition of such perspectives entail? A related question is less regarding the environment per se, and more the manner in which the particular recognition of an environment crisis generates different responses, requiring a sensitivity in considering these responses; a Rashomon position if you like, would be sensitive to the multiple interpretations and reactions in such a context of crisis.

In this chapter, I seek a Rashomon-like sensibility towards a term increasingly used in discussions of the environment and crisis, social innovation (SI). I wish to offer multiple interpretations of SI. The first is a straightforward definition of the term itself, using contemporary sources. What is social innovation? Why does it matter? Here I review the term, track its different contemporary meanings. My attention is on credible instances of it, observed during fieldwork in India and China. I also present some of the ecological contexts in these locations. However, this is not the only story I wish to tell. I wish to push this discussion further in terms of concerns of social theory and development studies. How do we interpret this attention to social innovation, in this contemporary moment? How do we characterize grassroots partnerships? What do these partnerships offer us in understanding and making tractable contemporary problems of the environment and development?

I begin by setting the scene for my research, noting trends of alarming environmental degradation in India and China during a period of climate change and global warming. After presenting this context, I turn to social innovation (SI) and present examples from fieldwork that illustrate its potential to challenge the environmental trends described, through grassroots partnerships. In the final section, I present an alternative classical focus on SI and attempt to resuscitate this in terms of contemporary ecological concerns. I argue for a renewed and reconstructed focus on grassroots partnerships that can enable greater attention to power and conflict. I offer three concepts, related to structural holes, tacit knowledge, and heterarchy that could support such a critical project, committed to a politics that reduces material and ecological inequalities.

## 7.2 A Context of Environment Degradation, Climate Change, and Decentralization

It is common today to speak of environments, the physical and material worlds that human beings inhabit, and ecologies, the nested interrelationships between human beings, other animal and plant species, in registers of pessimism. A note of gloom and a bleak picture contribute to a recognition that the world we inhabit at present is one that is despoiling, overexploiting and destroying the forest cover, species

biodiversity, and the natural resources needed for human and planetary survival. Nowhere is such pessimism more apparent than in the context of India and China. These two large countries have enjoyed high levels of industrial growth and material prosperity over the past three decades, but a prosperity offset by significantly increased levels of environment depredation and degradation. Leaving aside the obvious fact that a concept as complex as the environment demands more nuance than registers of pure pessimism or optimism, it is worth noting that it is possible to be both pessimistic and optimistic about it. A particular aspect of this complex accommodation (for want of a better word) is in the context of social innovation and the natural environment. Social innovation constitutes a form of agency, a response by people to the rapidly endangered and deteriorating state of their environment. Such responses also reveal increased sensitivity to the complex interrelationships of ecology, societies, markets, technology, and organizations. We could discuss social innovation in registers of optimism, as part of the capacity of human beings to resist deterioration of their natural environment, to find ways of responding in a manner that strengthens the environment, and themselves.

A pessimistic view gestures towards the dire state of the natural environment today, globally. It points to the trends of global warming and the manner in which the natural world is changing and the demands made on those who rely on it absolutely to adapt to these changes. As some livelihoods become precarious, social inequalities also worsen, since changing environments differentially affect the poor and those better able to insulate themselves from such changes. But optimism gestures instead towards agency and the manner in which human actors are resisting these trends. One such arena of agency is in social innovation and in terms of ecological response. In what follows, I present a contemporary account of what constitutes SI and flesh out this definition in terms of its ecological implications.

## 7.3 Social Innovation as Currently Defined

A well-known definition of SI describes it as "new ideas that work in meeting social goals" (Mulgan et al. 2007). A variety of foundation reports, journals, university research groupings, and even government initiatives have emerged that coalesce around the assertion that social innovation describes ideas that are practical, tractable, and new. On this basis, all of the following are examples of social innovation: fair trade, the Open University, the Grameen Bank, other nongovernmental organizations, and linux software (Mulgan et al. 2007: 47). Similarly, the Obama administration's newly created Office of Social Innovation and Civic Participation can claim that it is about "engaging individuals, non-profits, the private sector, and government to foster innovation and work together to make greater and more lasting progress" (White House 2013). In this instance, the dominant tenor is one less of ideational content and more about an engaging process with an end goal of innovation.

A more nuanced and precise definition of SI specifies that it is "new concepts, strategies, initiatives, products, processes, or organizations that meet pressing social needs and profoundly change the basic routines, resource and authority flows, or beliefs of the social system in which they arise" (Biggs et al. 2010: 3). Such a definition expands the thematic content, from not only being about ideas but also organizations and their social interactions; it also clarifies the end outcome as one of transformative and expansive changes (in terms of the social system). The definition brings out the relevance of authority, resources, beliefs, and organizational outputs and internal processes in terms of social innovation.

Through these three quotes we can identify the following definitional elements:

- Anything new in terms of ideas, concepts, strategies, products, or organizations
- A transformative and expansive end outcome, affecting multiple levels of a social system
- Involving processes of engagement that affect multiple actors

## 7.4 Ecological Management

How can we understand social innovation in terms of resisting ecological degradation? Ecological management has often been understood in terms of three guiding principles, ecosystems, stewardship, and diversity. The dominant interpretations of these principles have been towards sustainability, regulation, and biodiversity. Here, I wish to argue for an alternative set of concepts that better bring out the potential of SI for ecological management (See Tables 7.1 and 7.2).

### *7.4.1 Ecosystems: Sustainability or Resilience?*

How do local actions strengthen an ecosystem? Questions of ecosystems are frequently discussed in terms of sustainability. In a well-known definition from the 1987 Brundtland Commission Report, sustainability is described as being about meeting the needs of the present without compromising the ability of future generations (Campanella and Godschalk 2012: 224). Such a description is striking in its anthropocentrism—the environment is cast in terms of a resource to be sustained for future human needs. However, an alternative way of understanding questions of ecology is in terms of ecosystem resilience. Such an understanding moves away

**Table 7.1** Typology of ecological management

| Core concepts | The dominant interpretation | An alternative interpretation |
|---|---|---|
| Ecosystems | Sustainability | Resilience |
| Stewardship | Regulation | Co-management |
| Diversity | Biological | Associational |

**Table 7.2** Key findings from field work

| Region | Ecosystem | Degradation | Key responses | Shared governance |
|---|---|---|---|---|
| Southwest Rajasthan, India | Semiarid, hilly terrain with forests and shared rangelands; concentrated and sparse groundwater reserves | Deforestation, forest encroachment, polluted water reserves | Creating village bodies; subsidized pumps; cleaning water sources | NGO-led: *Seva Mandir* working with village groups; no state ministries involved |
| Telengana, India | Arid scrubland; limited groundwater | Desertification, depleting water reserves | Village government; rainwater harvesting | NGOs such as the Deccan Development Society with village groups; selective state involvement |
| Lashihai, West Yunnan, China | Semi-humid, sandy soil around a lake | Farming and tourism is reducing water size | Creating alternative incomes, community monitoring of resources | NGO led: Green watershed; sporadic and tense relationship with government |
| Gaoligongshan, West Yunnan, China | Semi-humid, mountainous and thickly forested; very high biodiversity | Deforestation, encroachment | Community monitoring; alternate income sources (beehives, carpentry) | Government led: state ministries create local bodies with aid agency |

from a concern with human needs, to recognition that human needs are nested relationally, within clusters of natural and social systems through which natural resources are exploited. The question then becomes in what ways we understand ecosystems and what is needed to strengthen them. Questions of degradation are no longer questions of how to return to an existing relationship to the environment (which is what concerns maintaining sustainability). Rather the question is how to strengthen an ecosystem, so that it is resilient, able to withstand well-changing climates and natural disasters (Adger 2000; Berkes & Jolly 2001).

### *7.4.2 Stewardship: Regulation or Co-management?*

Discussions of the environment are also discussions of who will be responsible for its governance. Who stewards it? One way of discussing such stewardship is in terms of the state, and what it can do to maintain an amicable level of human use of the natural resources within the environment. However, an alternative way of

considering this question of stewardship is in terms of shared governance. This would mean recognizing that multiple actors reside within ecosystems, and therefore questions of stewardship are also questions of identifying these actors and holding them accountable towards environmental impact. This moves the question away from the state and towards those residing within an ecosystem (including humans but not restricted solely to them) and their forms of governing environment use. So, co-management refers here to the implicit and explicit partnerships between state actors and nongovernmental actors especially in terms of those residing with an ecosystem. Through what arrangements are these responses coordinated? Who is involved? What is the role of the local state actors?

### *7.4.3 Diversity: Biological or Associational?*

Finally, discussions of the environment are discussions of two linked forms of diversity. An important aspect of the environment is biological diversity, in terms of the variety of plant and animal species present. Such diversity is in fact closely evoked by concepts such as resilience and ecosystems; *pace* claims of sustainability advocates, ecosystem governance must literally acknowledge the interlinked nature of the question of the environment. This interlinked nature is what a question of biodiversity evokes since it notes that the diversity of a particular ecosystem embeds the interdependence of its constituent parts. That is, the ecological value of diversity is in the flow of energy between these actors, a flow that regenerates the ecological setting. One example of such diversity is brought out in the well-known book of Geertz (1963) *Agricultural involution*, when he describes the ecology of a paddy field in terms of how much rice yield can be squeezed out of it. Such fields are periodically flooded with water; ducks are released and they navigate the water, and eat pests that would otherwise attack the crop. They also consume frogs that live in the paddy field and survive on insects including the pests. The interlinked consumption of the ducks, the frogs, and insects returns nutrients to the paddy fields. Studies have shown the age of these fields, and how they have supported paddy cultivation across centuries through this agriculture (Lansing 1991).

In a similar manner, we could imagine the diversity of associational society. Where biodiversity signifies the diversity of natural and human species that exist within an ecosystem, associational diversity signifies the diversity of groupings through which these actors are represented. The greater the variety of such groups, the higher the diversity. To some theorists of civil society (Edwards 2004; Srinivas 2009), higher variety signifies greater public discussion, possibilities for disputation and transparency of those who hold power. It offers a potential for a particular kind of politics (Srinivas 2009), where citizenship is exercised by seeking an expansive engagement with the ecological question. What forms of civil society are important for such ecosystem response? Does one type of organization prevail, for instance, NGOs? What is the consequence in terms of stewardship of diversity and lack of it? These three areas are summarized in Table 7.1.

## 7.5 Field Study Information

In fieldwork in India and in China, my interest was to understand the role of social innovation in ecological degradation. I directed research towards a set of concepts: resilience of ecosystems; co-management; and associational diversity. My information gathering focused on: characterizing ecosystems and their boundaries, identifying dangers of degradation, and of forms of stewardship. I studied the impact of climate change; responses of local communities, civil society groups, and the state; and the modes of shared governance between these actors. Table 7.2 summarizes the information gathered using the following categories: description of the ecosystem, problems of degradation, responses of civil society, and forms of shared governance.

### *7.5.1 Telengana*

Located in the south-central Deccan this is a deceptively arid region. There are water reservoirs, greenery, and fields. But it is difficult terrain: water is scarce; irrigation is not plentiful. What appears green includes thorn bushes, and groundwater is limited. Over the past two decades, water reserves have further depleted, and fragile lands teetering on the edge of aridity have desertified due to limited water supply and greater resource demands. At the same time, the region has become charged by the struggle for statehood. Politicians claim that the region's enduring poverty is due to its people being deprived of natural resources by competing regions. Similar claims have been made in other areas of Andhra Pradesh, notably Rayalaseema which remains the poorest part of the state. Both Rayalaseema and Telengana suffer periodic droughts, and assertions are made at such times of severe biases in state allocation of resources and investments, including water sharing. But another way of studying this matter would be to acknowledge that growing population, urban and industrial pressures, and possibly, shifting trends in climate, have exacerbated an already fragile ecosystem.

In this context, a unique trajectory of social innovation is associated with the Deccan Development Society (DDS). It works with village-level organizations and promotes nested policies that strengthen community level food autonomy and control of water resources. These village organizations, sanghams, are encouraged to develop conservation strategies that accommodate internal inequalities. Such accommodation occurs in part because the DDS' focus is on historically underprivileged groups in these localities. So it focuses on dalit communities that lack the land and irrigation facilities available to more powerful ethnic groups. But the other aspect of such accommodation is the nature of the sangham itself. Following a democratic process, with a focus on dalits, it is inevitable that its chosen process of conservation will have to be sensitive to internal inequalities.

The staff I interviewed at the DDS emphasized specific practices and technologies. Sanghams reduce water needs by planting a wider variety of crops and by avoiding

water intensive crops such as rice. In part, this requires not only different planting cycles but also change in diets. Millet is a traditional and hardy cereal that has lost prestige to more resource intensive crops such as wheat and rice. In promoting such an alternative crop, the DDS is confronting current food policies of the Indian government. The government offers subsidies for low-income communities for cereal purchase. Policies are skewed towards the production of wheat and rice and steer the local people away from food production. They are encouraged to plant cash crops, use the money earned to purchase subsidized cereals. Alternately, following the DDS model, they can change their eating habits, become less reliant on this distant supply chain, and become more autonomous as a result. Besides water conservation through different crop planting, the DDS also encourages rainwater harvesting. Being an arid region, the farmers seek to store water during the monsoons for later use. Traditional ponds have been used in this region as a form of harvesting of rainwater, and the DDS promotes their use.

### *7.5.2 Udaipur*

Located in the south western part of Rajasthan, and on the southern slopes of the Aravalli ranges, the region around the city of Udaipur is quite different from Telengana. The terrain is hilly, with dispersed villages separated by hills and forests. Groundwater is concentrated and not easy to access. Like Telengana this is a region marked by severe enduring resource inequalities. Once part of a kingdom, the royal class and attending nobles offered some infrastructure to reduce inequalities. Tanks were dug to store rainwater and to share groundwater. But due to the region's topography, the reach of irrigational canals is limited. Farming has typically taken place close to water sources. The region is also marked by forestlands that were historically royal hunting preserves. These preserves are today government-controlled revenue forests. They have gradually been encroached, some of their fringes transformed into cultivable land. As a consequence, forest cover is decreasing. These encroachers include poor tribal communities, the adivasis, as well as wealthier members of villages (Fig. 7.1).

In this context, the NGO Seva Mandir works in various communities, offering a variety of services. A well-respected venerable NGO, Seva Mandir's work includes a distinct ecological aspect. Its focus is on decentralized governance of local resources; like the DDS it too encourages village level institutions that can conserve local resources. However, unlike the DDS its focus is on following existing state regulations, which means it discourages any form of encroachment regardless of the community involved. And unlike the DDS, its village institutions are not defined by ethnicity and are instead expected to serve all local level members. This position has opened the NGO to some criticism. To writers such as Kashwan and Lobo (2014), such a policy lacks sensitivity towards encroachers whose actions stem from economic desperation. At the same time, its efforts are hard pressed to tackle existing social disparities which in turn influence selective

**Fig. 7.1** The semiarid landscape of the Aravalli hills. A woman looks towards fields behind me that are irrigated by the rainwater pond next to her, near Udaipur (photo by Nidhi Srinivas)

enforcement of existing laws. In short, the NGO has found it hard to actually implement a consistent non-encroachment policy in the first place, given the vested interests in these locations.

During field visits, I was impressed by the engagement and dedication of staff, and the variety of work accomplished (Fig. 7.2). Maintaining a matrix structure of operation, where managers simultaneously report to an area coordinator and to an expertise coordinator, the organization expects and institutionalizes a high capacity for negotiation. Such negotiation is apparent not only within the organizational structure but also in strategies of outreach and resource conservation. The delivery of results is closely connected to village assemblies. The offices have neat organization charts in local languages, typically with the conventional hierarchy reversed (i.e., the actual senior managers are represented at the bottom of the chart, implying their expected accountability to clients). Organigrams show circles of engagement, not a top-down chain of command. In these ways, the iconography emphasizes the effort to move away from hierarchical to collaborative, relatively egalitarian, work arrangements. And indeed matrix structures work well when staff are offered a high level of autonomy and expected to follow their own judgment in the novel situations confronted. In a sense, having two bosses simply means having no boss at all, when possible.

However, conversations and observations also showed a pattern of conflict: the effort to develop consensus could blur severe differences. A staff member informed

**Fig. 7.2** A Seva Mandir manager's motorbike at a village, during his routine visit (photo by Nidhi Srinivas)

me bitterly, in Hindi, that English speakers were paid much more and enjoyed senior responsibilities unavailable to equally experienced Hindu speakers. The staff also told me that English speakers benefited from the experience and insight available to the Hindi speakers, while their titular work superior. Senior leaders were admirably open to discussing these issues. Their response was pragmatic, labor markets were what they were, in the NGO world English was at a premium. However, a larger question worth posing is not solely about whether such inequality should exist. Rather it is *how* such inequality should be acknowledged in their line of work?

Seva Mandir's work shows a variety of social innovations, notably in terms of user groups, intermediate technology, and reclaimed/improved water sources. The innovations require a high level of cooperation across resource-unequal actors. Farmers at a groundwater reservoir displayed account books; they had formed a user group as part of the conditions for a Seva Mandir grant. The NGO paid for the pump set in the expectation farmers would cooperate in funding fuel costs. The account books listed the names of each subscriber, time usage, and fuel costs calculated for such use. When I asked how the time of use was decided, I was told it required much negotiation. Farmers often need water at the same time: they have to work out turns, preferences must be fair and appear just. Again the expectation was that Seva Mandir's grant would encourage members to work together, find a way to handle internal differences. (But of course, it is not clear to what extent such an

effort actually respects these differences and ameliorates them, or simply smothers their expression). There are ecological implications of such an innovation. Now able to farm through access to water, user group members need not cut down nearby forests to sell the timber. They need not encroach on reserve forests. Importantly, they work together and strengthen skills to handle conflicts, to share existing scarce resources.

At another village, Deelwara, a well-known Jain pilgrimage destination, I was shown village tanks drained, cleaned, and repaired by village assemblies. The assembly had hired cleaners to collect garbage, separate the compostable refuse. In this way, the cleanup had created a network of obligations, both monetary and social, with virtuous ecological consequences. They now enjoyed cleaner water and had streets with functioning garbage collection.

In Sisvi, an assertive village elder refused to share a water source. The meeting became heated. His declarations were made to an audience that included Seva Mandir staff visiting from the Udaipur office as well as village level staff and the village assembly. The latter's leader as well as the NGO staff responded politely and vigorously during the discussion. Again the emphasis was on negotiating between actors with very different resource entitlements. And indeed the staff with whom I had made this visit, informed me as we left, they expected the village elder to accede, to share his water source with the rest of the village by offering them some access to it.

### *7.5.3 Lashi Hai*

The visits to China involved two locations in Yunnan, a south-west province bordering Myanmar, Vietnam, and Laos. The first is a lake situated outside Lijiang, an ancient city reconstructed after a severe earthquake in 1996. Favored by domestic as well as international tourists, it wears a festive and souvenir-oriented air. Tourists visit the town for its unique ambience, a preserved quality to the architecture that marks it different from the larger, bustling, and more anonymous urban landscapes elsewhere in China.

Outside Lijiang is the lake Lashi Hai. This is a large highland lake at 2200 m. The lake is an important site for Himalayan migratory birds. The wetland ecosystem comprises semi-humid sandy soil, and a variety of forest species and migratory birds. I visited the fringe of the lake and one of the villages located there. The ecotourism group with whom I traveled brought bicycles for our use. Biking was frequently interrupted by groups of tourists from Lijiang, who visit the lake to ride horses. Tourism is an important source of local income but also a severe threat to ecological balance. The incursion of horses, dumping of animal waste in lake waters, have caused problems. Government officials have also dammed parts of the lake to increase water availability for Lijiang. Therefore, the key environmental problems are degraded water reserves and encroachment of lake borders. The increase in tourism as well as damming of upstream waters have reduced the lake's size and affected water quality.

Key environment-related solutions at present involve alternative income sources and community monitoring, led by an important local NGO, *Green Watershed*. The NGO has developed a strategy of multipronged engagement: conserving existing tree cover in villages and planting fruit trees, locating alternative livelihoods for villagers including fishing and relying on participatory methods. The NGO in this sense is a partner with local level actors seeking to maintain their ecosystem. Green Watershed has become quite visible, receiving numerous awards, increasing the prominence of its leader and founder Yu Xiaogang. The NGO is featured in prominent press releases as an exemplar of engaged environmental work. It has been an advocate for participatory watershed management; it has also criticized provincial government plans for further damming of the Salween River (Nujiang). Its approach is community based, focused on long-term change, not immediate short-term impacts. For instance, planting fruit tree and shifting villagers towards alternate livelihoods is not amenable to immediate dramatic results. But in time, it shifts human actors in this ecosystem away from activities that further exacerbate the deteriorating water quality and towards activities that increase ecological strength.

### *7.5.4 Gaoligongshan*

I also visited three locations in the Gaoligongshan region of Western Yunnan, a high altitude forest. The Gaoligongshan is a "hot spot," with the highest levels of biodiversity on the planet. Walking through its forests is a special experience. You can see an expanse of misty tall trees. There are weird echoes of birds and insects. The calls resonate in the otherwise silent surroundings. The three sites visited were in different parts of the Gaoligongshan. The first location is close to Baoshan, on the Eastern fringe of the Gaoligongshan and away from the border with Myanmar. Here, I met with staff of a Center for Mountain Eco-systems project in the Yang Liu watershed. This showpiece project seeks to regenerate tree cover and strengthen village autonomy. I then crossed the Gaoligongshan by bus to Tengchong on the Western side of the forest reserve, closer to the Myanmar border. Here, a government project helps villagers find alternative income sources, while maintaining the ecological codes that govern the forest reserves (Fig. 7.3).

The Gaoligongshan is a semi-humid mountainous forest ecosystem. It has thick forests, a high variety of plant and animal species. It also covers differing altitudes, being a series of peaks with villages on the plateaus below these peaks. The heights look down on rivers that flow onward to become the most important in countries that neighbor the region, including the Mekong (Lancang) and Salween (Nujiang) rivers. When driving through this region, it is hard to imagine it is under threat. The forest cover is incredibly thick. At times, the sun seems to have set, and the road flows below clumps of trees. However, you also notice trucks laden with timber, areas of stark muddy plains where trees have been cut, gorges from which rocks and minerals have been mined, and these indicate another story. The core environmental problems are deforestation and encroachment. It is hard to monitor the use of forests

**Fig. 7.3** The thick and diverse forest cover of the Gaoligongshan (photo by Nidhi Srinivas)

and in some areas local officials have cut down trees for profit, as informants told me. The communities within the Gaoligongshan are governed by laws that mandate the borders of villages. Villagers can cut trees for their use or sale within a certain boundary of the village. However, they cannot cut down trees further in the forest although they can enter these areas for activities such as beekeeping or mushroom farming (Fig. 7.4). Therefore, the interaction of human beings with the natural environment is especially sensitive here and calls for a nuanced approach to environmental governance.

The solutions to these environmental problems have emphasized community level monitoring of the ecosystem while providing alternative income sources to reduce dependence on timber. These include technological solutions such as improved beehives, energy efficient stoves to encourage villagers to not only purse alternative income sources but reduce their energy footprint in doing so. The co-management is led by government ministries working closely with Dutch aid agencies, and, through such funding, Chinese NGOs. Through such work, the Ministry has promoted environmental solutions and created village-level committees to lead these efforts.

## 7.6 Social Innovations Observed in These Field Visits

Using the definition we have surveyed earlier, we can identify a variety of social innovations that vary in scale and technology. They include beehives, wood burning stoves and pump sets, technological solutions customized for local uses. They include

**Fig. 7.4** An improved beehive model shown by a villager in the Gaoligongshan region; the beehives enable the villagers to locate alternative income sources (photo by Nidhi Srinivas)

working groups to raise funds and to share technology among members. At times, these two forms of social innovation overlap, such as the user group that operates pump sets and allocates costs internally. But there are also working groups at a larger scale of operation, such as in Deelwara, to clean up water tanks and dispose garbage. These are not technological as much as institutional innovations, new forms of organizations to better respond to the ecological setting. Other such innovations include community forest wardens in the Gaoligongshan, village councils in all the sites studied to monitor access to the commons and for resource sharing. It includes the seed banks and night schools established by the DDS in Telengana and the schools of the Green Watershed in the Lashi Hai. Finally, one can also at a higher scale of operation recognize policies or strategies that are innovative, including the approach to ecological stewardship of the Green Watershed and at the Gaoligongshan project, and of land regeneration and watershed management of the DDS and Seva Mandir.

While these SIs vary in scale and use of technology, they do share three characteristics noted earlier in the typology of ecological management. First, they contribute to the local environment in a specific way, to ecosystem resilience. Resilience points to the long-term learning and adaptation of an ecosystem. In the immediate sense, it points to the ecosystem's capacity to withstand shocks; in an important sense, it also points to the ways in which inhabitants of the ecosystem withstand shocks.

Secondly, these innovations rely heavily on principles of co-management of natural environments. The ecosystems are managed by networks and not by a

single actor. The networks are led by NGOs, state ministries, and often a combination of both, and require the efforts of local users, to be successful. They signal a shift in environmental governance, away from a reliance on state policy alone, to a more complex and subtle set of incentives and mechanisms. However, crucially these innovations do require state actors to be willing to commit to such co-management. Research has shown the drawn out negotiations required in China to work with government ministries (Gilley 2012; Hsu 2010). Without such support, it would not be possible to consider co-management. In India, by contrast government cooperation is not a precondition; however to be successful, there does have to be some explicit mechanism for government and NGO actors to cooperate.

Thirdly, these SIs demonstrate associational diversity. By this, I mean a variety of associations that do not share organizational characteristics. Like biodiversity this variety maintains a high diversity of organizational forms and encourages unusual pollination and cross-breeding that could signal future ecological adaptation. A variety of groups mobilize for ecological response in these cases, from village councils, state-mandated bodies, state ministries, registered NGOs, formalized networks, aid agencies, traditional councils, and indeed parallel government bodies (in Telengana and in Udaipur).

## 7.7 Moving Towards Innovative Grassroots Partnerships

Climate change continues and those lacking the material means continue to bear the worst of it. I met and studied the lives of some of them, the herders and farmers in the Aravali Ranges, in the Deccan, the foragers and beekeepers in the Gaoligongshan, and the villagers around the Lashi Hai. I would like to humbly contribute to these lives by considering possibilities for grassroots partnerships that suitably combat the environmental degradation these communities now face.

In order to do so, I wish to consider the genealogy of the term social innovation itself. In an invaluable series of reports, the Québécois scholar Benoît Godin (2012) has explored the history of innovation (Fougère & Harding 2012). As he shows, the phrase social innovation is hardly a contemporary term. It has been in use for over a century, used in that time to characterize social change. During the mid nineteenth century, the phrase social innovation was used by French, English, and American scholars to describe forms of social change. It denoted dramatic socialist change as well as gradual social reform. Within another half century, these initial meanings would become obscured, as interest grew in the impact of technology on society. Technology was changing rapidly and society could not keep up with these changes. Social innovation was therefore what was required for society to adapt to these technological innovations. Social innovation now began to approximate what would become its contemporary meaning, connoting whatever is new (Godin 2012: 28). Within 150 years, the meaning of social innovation shifted from socialist change, to gradualist social reform, to social adjustments to technological change. Therefore,

social innovation is best understood as "part of a semantic network of terms, all of old origin… resurrected from time to time to put emphasis on the social" (Godin 2012: 42).

The term originated in a socialist impulse and reactions to that impulse, the recognition of how capitalist growth creates and relies on social inequality. Socialist projects sought to curb the market to reduce the impact on inequality and in varying ways. Initially, SI was what was anti-capitalist and what was socialist. It was also rapid and violent change and to many who named it such, to be abjured. But today SI stands for the opposite, for efforts supportive of capitalism, celebrating the shock of the new, while seeking to moderate the negative effects the change causes, in the hope such amelioration strengthens adjustment to capitalist systems. In this contemporary sense SI seeks balance, to counter the extreme effects of marketization, in the hope of a more harmonious accommodation to capitalist shifts.

It is worth returning to social innovation in its classic sense. In its original meaning, it represented no less than a dramatic change of political structures, a revolutionary shift of power. This is why commentators wrote of it in the context of worker insurrections and socialist aspirations: the term emerged in a ferment of agitation against the prevailing capitalist systems of that time and sought an alternative. In its classical meaning, social innovation involved a transformation of social relationships, through ideas, materials, and politics. For these reasons, SI is seriously misunderstood when seen as synonymous with innovation, social entrepreneurship, or the work of nonprofits. Or when it is reduced to an opportunity for citizens to become entrepreneurs, substitute for the state and so forth. Its historical scope has been far more ambitious than this; it has been to change the very nature of society at that point in time, and in that locale, on the terms of those within it.

SI remains characterized by three distinct features that require a conceptual clarity to offer greater support to grassroots partnerships such as those depicted in this chapter. Firstly, it is social. The focus is on social relations, what they are and what they should be. Therefore, we require middle-range concepts that can help us better understand the interplay between ideas, materials, and social relation. One such useful concept is tacit knowledge, customary skills, and practices that are hard to formalize, and which enable the daily life within a locale (Scott 1998). Such tacit knowledge generates opportunities for codifying, that is, for making such knowledge more explicit. In terms of the sites, I studied the social innovation entailed in water harvesting by the DDS, which requires reducing water usage, and building water cisterns, is an example of the use of tacit knowledge. These localities in the Deccan, like their counterparts in Rajasthan, have for centuries used their knowledge of traditional water harvesting techniques, traditions that are now gradually becoming codified.

Secondly, it requires networks through which these ideas and materials are advanced. These are multifarious networks not controlled by any one entity. They are better imagined, metaphorically, as a set of loosely knitted ropes, pulled and pushed by a range of actors, and simultaneously; this makes it quite hard to expect force exerted over say one rope to have always the same needed effect. There is a reason why Seva Mandir functions in a matrix structure. The NGO has two axes of authority based in sphere of expertise and region of operation. At any given time, a manager

simultaneously reports to (say) the Head of Natural Resource Development as well as the zonal manager for Deelwara. In a sense, this is an internal network. At the same time, the NGO's work relies on external networks including ones it has formally organized. This external social system is unusual since one could argue that the goals would be better achieved without it. For instance, if Seva Mandir wished it could regularly audit the villages, locate water wells, and hand pumps that do not function and repair them. But its managers insist on local committees holding meetings, where such an audit is reported and transmitted to Seva Mandir. The organization's commitment to democratic institutions perhaps explains the endurance of this externally formalized social system. Yet, there is also a functional reason at play here. Through such networks the NGO can better adapt to the demands of clients and ensure their responsibility in implementing some of the proposed avenues for change.

A helpful concept in this regard is that of structural holes (Burt 1992), areas of disconnection, where complementary information is latent but not shared. Think of someone sipping a coffee, seeking an apartment, and another in that restaurant who has one to rent, neither aware of the other. Such structural holes generate opportunities for brokering, for locating information gaps and bridging them. A considerable focus of much NGO work today is precisely this. Consider the use of social media to offer real-time information, such as on water availability, or disaster relief supplies. Technology is used here to plug structural holes. In the process, however, something interesting happens: the information shared acquires a capacity to reorder structures of power. For instance, disaster specialists, flown in for expertise by governments and aid agencies, now find their role must accommodate to the information generated by these shifting and emergent forms of sharing.

Thirdly, these networks themselves share an internal feature of importance. They are hard to fit within an image of a hierarchy. Yes, Seva Mandir has organizational charts that explicitly identify internal responsibilities. Yet they do not list the village assemblies within these charts. The assemblies are part and yet apart of the organization, linked to the NGO's staff in varied ways, but legally and in reality separate from the organization. This model of engaging with localities cannot be understood in terms of hierarchies alone. It is closer to an image of heterogeneous, unequal, autonomous actors that find ways of linking with one another, in ways that may not be enduring. A helpful concept here is of heterarchies, cross-cutting interdependent networks (Stark 2011). While such networks generate opportunities for collaboration, they function well in terms of negotiating heterogeneous information and shared goals. They function poorly when order is enforced, similarities demanded, that is when imagined as hierarchies.

## 7.8 Conclusion

If we are to discuss social innovation, stating it as new ideas, a transformative outcome, or process of engagement, is insufficient. We need a deeper reflection on the history of such terms and on the political ends sought through such work. We also require

better middle-range concepts for a nuanced understanding of the transformative quality alluded to, even implicitly, in such performative phrases.

Governments appear to be eager to do less, decentralize further, spend less on protecting the environment. The question of ecology gets further marketized. Ecological management is seen increasingly in terms of market-based incentives that will somehow (at the same time) allow for conservation, livelihoods as well as current rates of global resource exploitation. Social innovation in this contemporary context is a phrase that brings groups together, generates a particular affinity, between those with foundation funds seeking a visible impact, those seeking a way of curbing and challenging an authoritarian state through Tocqueville style citizenship activism, and those wishing to ground technological growth in social norms that adapt to them. Corporations are willing to fund it, government become interested in it, and on this basis the term generates a normative pull on these actors. This is the space grassroots partnerships occupy. However, a commitment to social innovation in its historical classical sense will also require a focus on those within these locales, increasingly endangered by climate change, and a credible effort to understand their battles and ensure they are not defeated in them.

**Acknowledgments** I am most grateful to Yang Shuo for her invaluable assistance in Baoshan and Tengchong. This report would not have been possible without her selfless, generous, astute and thoughtful questions, translations, and discussion. I am also most grateful to Ronak Shah who accompanied me on field visits around Udaipur, and was a wise, knowledgeable, and considerate companion. I thank Shailendra Tiwari and Neelima Khetan at Seva Mandir, Udaipur, Giridhar at the Deccan Development Society, Hyderabad, and Xu Jianchu, Yang Mei, and He Jun at the Center for Mountain Eco-systems, Kunming, for their assistance during this research. I also thank Martin Fouguère for alerting me to the work of Benoît Godin on innovation studies, and Manjari Mahajan on the work of Seva Mandir. Finally I wish to acknowledge the support and friendship of Sanjay Reddy, Eduardo Staszowski and Mariana Assis, as well as of Shikui Dong, Sanjay Chaturvedi, Victoria Marshall, Jayanta Bandyopadhyay, Ashok Gurung and Grace Hou.

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# Chapter 8
# Coastal Mangrove Forests: Micro-Geopolitics of Resistance and Social Innovation for Environmental Sustainability

**Sanjay Chaturvedi**

**Abstract** This chapter argues that at the heart of social innovation for environmental sustainability are the issues of space, scale, and power, which present themselves in the form of various puzzles, especially when approached in the context of climate change. Since communities are the basic building blocks of "social" they remain central to "social innovation." Taking as its key examples the Indian Sundarbans in the Bay of Bengal and Zhangjiangkou Mangrove Forestry National Nature Reserve in Yunxiao county of Fujian province of China, the chapter shows how communities located on sites characterized by multiple marginalities (geographical, socioeconomic, and cultural) perceive and approach impacts of environmental unsustainability and incremental climate change in both material-physical and ideational-representational terms. Environmental sustainability, both on land and at sea, is unlikely to be realized in the absence of a pursuit of social innovation through a micro-geopolitics of resistance anchored in participatory democracy and environmental-social justice.

**Keywords** Coastal marine environments • Environmental sustainability and unsustainability • Ganga-Brahmaputra-Meghna • Zhangjiangkou • Mangrove forests • Micro-geopolitics of resistance • Social innovations

## 8.1 Introduction

The *coast* and the *coastal*—a space-place composed of diverse interacting/overlapping natural, socio-cultural, economic, and political systems—force us to think somewhat differently, and even more innovatively about both 'sustainability' and

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S. Dong et al. (eds.), *Environmental Sustainability from the Himalayas to the Oceans*, DOI 10.1007/978-3-319-44037-8_8

'environment', as compared to hinterlands. Coastal communities in China and India, especially the poor and the marginalized, are adversely affected by the serious degradation of their coastal-marine environments due to population growth, urbanization/industrialization and tourism, pollution and sedimentation, loss of habitat and biodiversity, markets and technology, development of coastal aquaculture, overfishing and changes in access rights, etc. (Crain et al. 2009). Innovative as well as effective policies and action are needed to ensure not only continuing access for these communities to increasingly diminishing resources and declining opportunities, but also prospects for livelihood diversification. Global warming and climate change have further added to mounting concerns and uncertainties. As pointed out by the *Global Ocean Commission* (2014: 12), "The international community has expended a tremendous amount of political capital and diplomatic effort on establishing policy commitments aimed at reversing ocean degradation. Unfortunately, there remains a huge gap between the commitments expressed in various policy documents and the willingness or ability of States to implement them."

According to the fifth Assessment Report of the Intergovernmental Panel on Climate Change (IPCC AR5 2014: 1330), overall, "Coastal and marine systems in Asia are under increasing stress from both climatic and non-climatic drivers (high confidence)." Furthermore, "It is likely that mean sea level rise will contribute to upward trends in extreme coastal high water levels. Mangroves, salt marshes, and seagrass beds may decline unless they can move inland, while coastal freshwater swamps and marshes will be vulnerable to saltwater intrusion with rising sea levels. Widespread damage to coral reefs correlated with episodes of high sea surface temperature has been reported in recent decades and there is high confidence that damage to reefs will increase during the 21st century as a result of both warming and ocean acidification. Marine biodiversity is expected to increase at temperate latitudes as warm water species expand their ranges northward (high confidence), but may decrease in the tropics if thermal tolerance limits are exceeded (medium confidence) (Ibid.)." No doubt both communities and governments have become more aware of the marine and coastal ecosystems and their value to humankind, especially in the era of climate change. "But inevitably, as coastal populations grow, ocean exploration and exploitation increase, and new uses of the oceans emerge, more sophisticated and proactive approaches to protecting the oceans and ensuring their long term sustainable use will be required. No single approach will work everywhere, but comprehensive, multisector, multiobjective management provides an essential framework for effective coastal conservation" (Crain et al. 2009: 58).

What China and India share in common today—against the backdrop of neoliberal economic growth, growing populations, and resource scarcity—is the growing awareness about environmental degradation as well as resistance against it on both land and at sea. This micro-geopolitics of non-violent resistance also aims at a radical shift from domination to non-domination as the fundamental principle of more humane and socially just governance anchored in environmental sustainability. While it is true that non-violent resistance against domination and dependencies is nearly universal (Ackerman and Duvall 2000) and not a radically novel phenomenon, what often goes unnoticed is the large *scale* and brisk *pace* at which the micro-struggles against neoliberal globalization are unfolding in China and India

(Sheth 2004; Tilt 2010), despite significant differences in political culture and political system. The political as well as moral geographies of this resistance are also directed at demanding new spaces in which innovative people-centric solutions to environmental unsustainability could be realized.

The idea of *social innovation* for environmental sustainability through struggles at the micro scale remains central to chapter. The chapter aims at mapping out the bottom-up perspectives and priorities of water-dependent coastal communities, located on the geographical and socio-economic margins in China and India, with regard to environmental sustainability and climate change. I argue that since communities are the basic building blocks of 'social', they should remain central to both the theory and practices of social innovation. I take as my key (but not the only) examples the Sundarbans in the Bay of Bengal (enabled by a visit in December 2011 to the fast disappearing Ghoramara island) and Zhangjiangkou Mangrove Forestry National Nature Reserve in Yunxiao county of Fujian province in China (enabled by a visit in June 2012) in order to show how those subjected to multiple marginalities (geographical, socio-economic, and cultural) approach environmental unsustainability and climate change in both material-physical and ideational-representational terms.

I further argue and illustrate that both physical and human-cultural geographies are of paramount importance in any pursuit of social innovation aiming at environmental sustainability. Even climate change has a complex geography to it in terms of both causes and consequences. Moreover, the coastal zone, "a broad geographical area where the terrestrial and marine factors are mixed to produce dynamic/sensitive ecosystems" (Adarsa et al. 2012: 72) is a medium that forces us to think differently both about innovation and environmental sustainability. In the environmental policies of both China and India (countries with a long coastline, sizeable coastal communities, coastal zones, and ecosystems that are highly vulnerable to climate change), one finds a bias in favour of land or continent. Relatively speaking, the plight, priorities, and perspectives of coastal communities are often underplayed in both China and India.

The chapter begins with a brief but critical engagement with conceptual-analytical triad of space, scale, and power. In the section that follows, I question the natural-human dichotomy assumed by some of the framings of coastal-marine environment and argue that coastal marine habitats in large parts of Global South are not 'empty'. On the contrary, they are inhabited by millions of poor who depend for their survival and livelihood on vital 'ecosystem services' provided by the coastal marine environment. It is important therefore to acknowledge at the outset that the categories of 'social' and 'ecological' are not disconnected but mutually inclusive; a point also made by Dong in Chap. 5 and Srinivas in Chap. 7 of this book.

The chapter turns its focus next on the Sundarbans followed by Zhangjiangkou. It shows that even though these two inhabited sites of ecological importance are situated in significantly diverse political systems and political cultures, one finds striking commonalities between the two in terms of marginalization and disempowerment. A critical assessment of the national environmental policies and climate action plans of China and India follows with following question in mind. How is the challenge of sustainable coastal marine environments, now multiplied due to climate change, approached and addressed by the national policies of China and India?

The concluding part of this chapter examines the problems and prospects of achieving environmental sustainability through innovative social struggles in China and India. I strategically recall and revisit one of the most successful examples of grassroots movement for retaining controls over local resources by local communities that was waged and 'won' during 1970s and 1980s in the Uttarakhand Himalaya in India; the Chipko. I show how Chipko has inspired movements with similar objectives in other parts of India. The proverbial billion-dollar question then becomes: what are the prospects of movements of similar nature and objectives in China?

## 8.2 Environmental Sustainability in the Era of Climate Change: Rethinking Space, Scale, and Power

A critical examination of the politics behind the written geographies and spatial representations of coastal-marine environments reveals that the production of geographical knowledge at various sites (websites of government agencies, think tanks, media, tour operators, etc.) involves competing claims to 'know' space and scale in particular ways (Gregory 2009). There appears to be a growing conflict over various understandings and representations of the 'Sundarbans' and 'Zhangjiangkou' as a *space* (i.e. 'beautiful and exotic garden', 'world heritage', 'mangrove forests', 'national reserves', 'lungs of planet earth', 'blue carbon sinks', sites of eco-tourism), as a *place* (villages, communities, local histories, livelihoods), and as *a site/source* of ecosystem services. A number of questions arise once a critical social science perspective is invoked. Who has the power to frame various 'ecosystem services' in the Sundarbans and Zhangjiangkou, prioritize them and 'authoritatively' represent them in certain ways? What about the needs, values, and priorities of communities that depend on the ecosystem services provided by the mangrove forests of the Sundarbans and Zhangjiangkou for their livelihood security?

Deeply implicated in this clash of reasonings and representations is the question of 'appropriate' scale at which the challenge of environmental sustainability in coastal-marine environments could (and should) be addressed while searching for innovative ways and means. Despite a number of political geographers pointing out that socially constructed scale is both fluid and contingent, several questions demand further critical reflection in the context of climate change. What is the most appropriate regulatory scale (subnational, national, supranational) to approach the challenge of sustainable marine environments? How useful or effective is the hierarchical scale for addressing environmental flows, ecological networks, and ecosystem services?

These questions are not easy to answer because, as succinctly pointed out, "Scales do not exist 'as such'—independently of social and political processes and discourses—but are outcomes of practice-embedded categorization. They emerge in the course of production and consumption of narratives about scales, places, networks and territorialities and also take on material and institutional features" (Kangas and Moisio 2012:205). Some human geographers argue (Marston et al.

2005: 416) that "the dominant—hierarchical—conception of scale, presents a number of problems that cannot be overcome simply by adding on to or integrating with network theorizing" and propose "to eliminate scale as a concept in human geography." What they offer instead is a different ontology, "one that so flattens scale as to render the concept unnecessary" (Ibid.). It could be an intriguing and rewarding exercise to re-imagine and reconfigure the ontology of coastal marine environments as *networked* instead of *hierarchical* and to explore the policy implications of a social innovation *without scale* for environmental sustainability of coastal-marine systems.

As pointed out by Gregory (2009: 666) "scale itself, while no doubt an organizing moment in epistemology, has merely a transcendental status within the domain of ontology…scale is an epistemology that, though potentially helpful in a methodological sense, is tied to a global-to-local continuum that underwrites the problematic view that social processes can be detached from the grounded sites where people and objects concretely reside and social practices take place [e.g. coastal communities of the Sundarbans engaged in fishing to sustain livelihoods]. They offer in its place a *flat ontology* that resists conceptualizing processes as operating at scales that hover above these sites" [regions and nation-states].

Both Smith (1984) and Cox (1998) have talked about the political strategy of 'jumping scales' (which is much more than simply moving from 'local' to 'global scale') that communities grounded in specific localities choose to draw from national, regional, and global discourses to improve the prospects of their political struggles. And if power in its minimalist definition is the ability of one agent/agency to affect the actions or decisions of another agent/agency, a focus on the meanings, causes, and effects of power is pertinent to 'jumping' scales. We will return to the issue of 'jumping scale' and its importance for the coastal communities later in the chapter.

The issue of *temporal scale* is equally complex and compelling, both in geopolitical and ethical terms, while approaching the issue of environmental sustainability. The temporal scale becomes further convoluted in the context of climate change. Doyle and Chaturvedi have argued (2010, 2015) that in the neo-liberal era, when industrialism has been globalized and homogenized, 'environmentalisms' of various kinds, ably supported by green geopolitical discourses, seem to be competing with one another for greater visibility, authority, and legitimacy. The Enlightenment project, while grudgingly accepting 'natural constraints to growth', continues to champion increased growth through improvements to environmental efficiency and management. Most recently, this has been pursued under the key terms *sustainable development* and *ecological modernization.* Significantly, in terms of temporal scale, these environmental discourses place a strong emphasis on the rights of 'future generations'. Indeed these rights are one of the defining features of sustainable development as was first elaborated in the Brundtland documentation (1987) as *intergenerational equity*. This focus on 'future generations' is driven to a large extent by the Northern imagination that its global citizen-consumers have realized their basic material needs and can now pursue 'higher order' objectives set for the *citizens of the future*. It is conveniently forgotten at times that in poorer and domi-

nantly rural parts of the global south, movements for environmental justice and human security are motivated by basic issues of survival. For those who are already living (or struggling to live), threats to their basic survival and livelihoods are as much the result of extreme environmental degradation and hundreds of years of colonial exploitation as the outcome of industrialization and what Dalby appropriately describes as 'carboniferous capitalism' (Dalby 2009: 77).

As rightly pointed out (Harvey 1996; Williams 1998), various proposals seeking environmental change are not necessarily aiming at transformations for social justice. On the contrary, many environmental agendas seek to ideologically reinforce class privilege and the power that be to sustain capitalism. No surprise, subaltern perspectives look at apparently innovative concepts such as 'green economy' with a fair amount of skepticism bordering suspicion. They critique the manipulation of temporal-spatial scale by the powers and caution against an excessive focus on the *future* consequences of 'carbon footprints', which makes the long-standing ecological debt that the global North owes to global South largely invisible. These perspectives from below do not question the *future reality* of climate change, but do insist that the *present reality* of large-scale environmental unsustainability and related historic responsibility of the Western industrialized countries must not be overlooked. In short, these critical perspectives insist that incremental climate change and persisting environmental unsustainability are interrelated and thus should not be perceived, approached, and analyzed in isolation from each other.

## 8.3 Environmental Unsustainability, Climate Change, and Uncertain Futures Facing the Sundarbans

Covering less than 1 % of tropical forests globally speaking (which comes to around 0.4 % of the total global forest estate), mangrove forests "cover an area of only around 152,000 $km^2$ in 123 tropical and sub-tropical forests worldwide" (Van Lavieren et al. 2012: 3). Extremely rich in biodiversity and sustaining the livelihood and food security of millions of people around the world through the production of numerous fishery and forest products, the mangrove forests are "disappearing three to five times faster than overall global forest losses. Some countries have lost more than 40 % of their mangrove area over a 25 year period and many remaining areas are in a degraded state" (Ibid.). Some of the major anthropogenic interventions that continue to destroy and degrade mangroves include rapid population growth and high population densities in coastal areas, over-extraction and deforestation, infilling, drainage and conversion for aquaculture or other resource, agriculture, urban and industrial runoff, oil spills, and poorly managed dredging and coastal development (Ibid.). Termed as the 'blue carbon sinks', the mangrove forests serve as "highly effective global carbon stores and sinks" and in the context of climate change mitigation "they can also help build or maintain elevation in the face of rising seas" (Ibid. p. 3). Relatively undermined or neglected in many national climate

change action plans, the mangroves as 'blue carbon sinks' are now strong contenders for market-industry-driven clean development mechanism (CDMs) or carbon trading. I will be returning to carbon trading issues later in this chapter.

The Sundarbans, hosting one of the largest continuous mangrove forests in the world, shared by India and Bangladesh, are being increasingly perceived as well as widely reported in media as the 'first climate hotspots' in South Asia. Here is an outstanding example of a unique inhabited ecological region of exceptional value that is geopolitically partitioned and subjected to two different regulatory regimes. Designated by the UNESCO as World Heritage Site in 1987,[1] the Indian Sundarbans Delta (cited hereafter ISD), the western part of the delta of the Ganga-Brahmaputra-Meghna (GBM) basin, is home to over 4.4 million, largely rural, people.[2] About 40 % of the nearly 10,000 km$^2$ of the Sundarbans forest lies with West Bengal on the Indian side; the rest is in Bangladesh. The larger (eastern) part of the Sundarbans delta is in Bangladesh. As many as 54 deltaic islands (occupying a little over half of the area) are populated and the remaining space is covered by the mangrove vegetation. Extreme weather events, such as severe storms or cyclones, occurring at frequent intervals have a long history in this region. Needless to say, these 'natural disasters' do not recognize the geopolitical boundaries between India and Bangladesh in the Sundarbans.

According to the IPCC fourth assessment report (IPCC 1997), climate change-related increases in temperature and sea-level rise will adversely affect the mangroves. Whereas the temperature effect on growth and species diversity is unknown, there is little doubt that sea level rise will pose a serious threat to these ecosystems (Ibid.). The economic implications of anticipated ecological changes are quite significant. For example, in the three distinct ecological zones that make up the Bangladeshi Sundarbans, at least three species could be threatened in case the saline waterfront was to move further inland. These are: *Heritiera fomes*, the dominant species in the landward freshwater zone, *Excoecaria agallocha* in the moderately saltwater zone, and *Ceriops decandra* in the saltwater zone (Ibid.). "These changes could result in economic impacts: Direct employment supported by the Sunderbans is estimated to be in the range of 500,000–600,000 people for at least half of the year …and a large number of these people—who are directly employed in the industries that use raw materials from the Sunderbans (e.g., woodcutting; collection of thatching materials, honey, beeswax, and shells; fishing)—may lose their sources of income" (Ibid.).

It is important to note that ecological insecurities, likely to be multiplied as well as magnified by climate change, as currently experienced by the vast majority of inhabitants on both sides of Sundarbans, especially those engaged in fishing and agriculture, are marked by a complex spatial pattern including—but not exhausted

[1] The UNESCO Man and the Biosphere Program has included the Sundarbans Biosphere Reserve in the Global Network of Island and Coastal Biosphere Reserves contributing to Action on Climate Change and Sustainable Development.

[2] The Indian Sundarbans Delta is bounded by the Ichamati-Raimangal River in the east, by the Hugli River in the west, by the Bay of Bengal in the south, and the Dampier-Hodges line drawn in 1829–1830 in the north.

by—climate change-induced seasonal variation, floods, and droughts. As pointed out in a seminar study by WWF India:

> A pronounced ecological change is evolving in this delta due to huge discharges of untreated domestic and industrial effluents carried by tributary rivers as well as the disposal of contaminated mud from harbour dredging and resulting from the rapid emergence of the Haldia Port Complex, a major oil disembarkment terminal in eastern India. The Sundarbans delta has become susceptible to chemical pollutants such as heavy metals, organochlorine pesticides, polychlorinated biphenyls and polycyclic aromatic hydrocarbons, which may have changed the estuary's geochemistry and affected the local coastal environment (Danda et al. 2011: 7).

Implications of the above-mentioned contemporary realities for the overall biodiversity map of India are quite serious and far-reaching. Nearly 85 % of all mangrove habitats found in India lie in the ISD. At least seven of these mangrove species or species groups are at risk and demand immediate conservation measures. The WWF report reminds us that both the direct human activities and natural environmental changes are responsible for the degradation of natural ecosystems in the ISD. As far as the impacts of climate change on other components of the natural environment are concerned, except for changes in the physical components, "there is insufficient knowledge to attribute changes directly to climate change" (Ibid. 35). In order to fill existing gaps in knowledge, more interdisciplinary policy-oriented research is needed. Needless to say, this research will play a pivotal role in finding innovative solutions to reduce/replace uncertainty that comes in the way of taking sound management decisions.

The WWF Report further points out the persistent mismatch between the growing sense of urgency to find early, innovative, and effective solutions to increasingly complex management and 'development' challenges in the ISD and the struggling pattern of governance for this unique and complex system facing population growth and climate change. Consequently, changes are required "in the broader context of physical limitations of a delta system, national development and human settlement management, biodiversity conservation, and transboundary cooperation" (Ibid.31). Due acknowledgement of this broader context is necessary but not forthcoming.

> To date, the gravity of these challenges has not been publicly recognized. *The ISD is in need of early, proactive and informed interventions by all actors involved in the management and development of this area, especially the state and national governments.* The growing consensus among a vast body of scientists and experts from all over the world is that unless highly informed and sometimes bold changes in policy and governance are introduced, coping with the pressures of predicted changes will be nearly impossible. *In view of the grave situation facing the ISD and the fact that without much needed change, this environmentally and economically important area is rapidly heading towards an uncertain future… (Ibid. p. 31) (Emphasis given)*

Whereas the Sundarbans appear to be heading towards an uncertain future, a rather complex geometry of power, with highly contested notions of 'appropriate' space and scale, too has surfaced. Sundarbans continue to occupy a *peripheral* position vis-à-vis national and provincial geographical-political mainstream (i.e. vis-à-vis New Delhi and Kolkata), despite their growing *centrality* and visibility in the context of 'global' climate change. Whereas disempowered communities of the Sundarbans continue to struggle

on the margins of this periphery and experience extreme forms of vulnerability, livelihood insecurities and more recently multiple dislocations due to the incremental loss of physical habitat; the ground beneath their feet is increasingly shrinking.

A widely cited study on the Sundarbans, carried out by Dr. Sugata Hazara, Director, School of Oceanographic Studies, Jadavpur University, Kolkata, had revealed as early as 2006 that nearly two thirds of Ghoramara island had been permanently inundated due to sea level rise; whereas the islands called Lohachara, once inhabited by ten thousand people, and Supribhanga (both located southwest of Ghoramara) were completely submerged. Those displaced from the Lohachara Island had fled to an island called *Sagar*, which is said to be equally vulnerable (Sengupta 2007, *The Hindu*, 24 March 2010).

With an area of around 4.8 $km^2$ and a total shoreline length of 8.5 km, Ghoramara is located in the Hooghly river estuary (one of the largest estuaries of River Ganges), about 18.36 nautical miles away from the Haldia doc yard (Adarsa et al. 2012). Out of the cluster of small villages on this island[3], the Kashimara Char, Lakshmi Narayanpur, and Kashimara have been completely submerged. Inhabitants of this areas, which experience a tropical warm and humid climate, are engaged in agriculture and fishing. Ghoramara is 6.5 m above mean sea level and subjected to "stronger flood tides for shorter duration" since "the Hooghly estuary experience semidiurnal tide with flood tide of short duration, 3 to 4 h, and the ebb tide remains for 8 to 9 h" (Adarsa et al. 2012: 72).

Ghoramara has experienced significant morphological changes and erosion (Ghosh et al. 2013). According to one calculation, "the island has lost almost 50 % of its area over four decades due to severe erosion around all sides. *The decrease of fresh water influx in the Hooghly River due to natural and anthropogenic causes is a major cause of the instability of the island system…* Land use land cover map also shows a drastic reduction in the area of agriculture land and fisheries. Land use land cover calculations also showed that the island total area has been reduced from 9.09 square km to 4.8 square km." (Ibid. 81) (Emphasis given)

The population of Ghoramara in 2001 was close to 5000. Since then, a number of factors, based on both fear and the hope to overcome that fear, have forced migration and relocation of a large number of people to other nearby islands such as *Sagar*. These factors include severe coastal erosion, degradation of local environment, and loss of homeland and livelihood. Those who have been displaced from already submerged Lohachara and fast disappearing Ghoramara have been called 'environmental refugees' by various scholars, think tanks, and media; a term highly misleading and in need of close scrutiny. Timothy Doyle and this author have argued that, "…it is important to ask the people of the global South themselves [e.g. communities displaced from Ghoramara], as to what they think of the climate refugee frame. The fact remains that many in the global South resent their depiction as 'victims' within climate refugee discourses" (Doyle and Chaturvedi 2011). Furthermore, any attempt to broaden and deepen the 'humanitarian space' through

[3] The major villages on this island include Khasimara, Hathkola, Baghpara, Raipara, Mandirtala, Chunpuri Lakshmi Narayanpur and Khasimara Char.

**Fig. 8.1** Costal erosion of Ghoramara Island (photo by Sanjay Chaturvedi)

the introduction of the category of 'climate refugees'—despite best possible intentions on the part of various actors, agencies, or social forces—is likely to be "regressive rather than progressive, oppressive rather than emancipatory, and exclusive rather than inclusive" (Ibid.).

During my visit to Ghoramara in December 2012 and conversations with the local communities, what became graphically obvious early on was the vital, but often overlooked, distinction between geographical proximity and geopolitical distance (Fig. 8.1). In terms of geographical distance, Ghoramara is not that far from either the mainland Kolkata or the Sagar Island, of which it was a part before drifting away and stabilizing as a separate island in 1903. But in terms of access to and from the 'outside world', infrequent and ill-maintained transportation/ferry services, and lack of interest shown by both the government agencies and the NGOs (as pointed out by many on the island), Ghoramara appears geopolitically distant and socially remote.

As for the political attention given to Ghoramara and the plight of its inhabitants, at the time of March 2009 election in West Bengal, the challenge of 'stopping the island from disappearing' due to global warming was reported to be "the only issue" that "dominated the pre-poll scenario" and the election campaign of the two major political parties of West Bengal, namely the then ruling CPI (M) and the Trinamool Congress that eventually won the 2009 elections (Thakur 2009). Whereas the local population appears to be having a far more nuanced understanding of 'climate change', and in their view, there is much more to it than simply the drowning of their homeland. Issues like poverty and powerlessness, combined with steadily shrinking resource base and livelihood security, appear far more compelling to them

than the climate change rhetoric of the politicians, especially on the eve of elections. Due to the loss of land where betel nut cultivation is the mainstay besides fishing and prawn seed collection, the economic hardships of local communities have multiplied many a fold.

It is worth pointing out at the same time that poor villagers of Ghoramara have diverse understandings of which factors and forces are the key culprits responsible for the alarming erosion and serious loss of their coastline. Some residents, for example, did point out during informal conversations that the extension of the Haldia port by the West Bengal government had forced the water flow towards the island located at a distance of 12 km from the port, hitting the island hard and taking away the soil. As noted by a number of observers, during the 1970s, "the state government had drawn up the project despite warnings of increased frequency and intensity of cyclones and tidal floods. The proposed seven guide walls to contain ecological damages to surrounding areas have also not been constructed" (Philip 2015).

Irrespective of which side of the maritime boundary their homeland is (Indian or Bangladeshi), the poor communities of Sundarbans continue to lose land—and with that livelihoods—and face multiple displacements. As emphasized by Dong in the case of biodiversity conservation of the Himalaya—in Chap. 6 of the book—lasting and effective solutions to transboundary environmental problems have to be transnational, sub-regional, and regional. The same principle applies in the case of Sundarbans communities. However, the key policy responses to multifaceted problem of ISD have so far been largely national. Danda in his doctoral thesis on the Sundarbans (Danda 2007) has shown how the structural approach to secure Sundarbans has been deployed in the past by various government agencies and with little success.

While acknowledging the importance of embankments for sustaining human habitation in the Sundarbans, Danda has been quick to point out that, "Though the significance of embankments is local, the ownership is non-local in the sense that these are public property rather than common property and the onus of their maintenance rests on institutionalized collective action organization that is a level far too removed from the communities immediately affected due to breaches/collapses in embankments" (Ibid. 148). Danda sounds skeptical about the legitimacy, authority, and effectiveness of a policy response that tends to privilege a *scale* imposed from *far* and from *above* in complete disregard for the intimate and embedded nature of problems experienced at the local scale by the communities facing threats and risks.

In case of the obvious mismatch, as mentioned above, one might ask as to which of the following is more desirable from the standpoint of environmental sustainability in the Sundarbans: shifting/relocating the community to new spaces or shifting/relocating the scale of responsibility and accountability? According to Danda:

> *Shifting a large population of over 1.76 million out of the eco-region does not appear feasible given that rural West Bengal already has a population density of 676 persons per square kilometer.* Minimizing further degradation of the land mass is the only option to ensure that the population has the opportunity to develop with the rest of the country. Large-scale investments in concrete structures located further inland so that tides have the space to play is likely to allow more stability than currently possible. *Given the magnitude of*

> *physical forces, the global phenomena of sea level rise, the level of investment required for erecting and securing the structures, and the significance of the eco-region, it might be more appropriate to transfer ownership of embankments and the responsibility of maintaining these even further by several levels to the national level or even beyond since the Protected Area is of global significance and has consequences for the World Heritage site.* Moreover, it is not within the means of the State of West Bengal to make such large-scale investment (Ibid. 151). (Emphasis given)

In other words, since neither moving the walls/embankments further inland and closer to the communities—in order to create more space for the environmental-tidal flows—nor moving over one million people out of the eco-region appears to be cost-effective and feasible, it was proposed by Danda that 'minimizing degradation of the landmass' was the only option that would also allow communities to 'develop' with the rest of the country.

The 'Delta Vision' of the 2011 WWF Report (with Dada as one of the lead authors), however, talked about "enhanced protection for human economic activities together with restoration of mangrove forests, and encouragement of phased and systematic outmigration" and suggested a four-phase approach. Central to the vision, among various other suggestions, is the reconstitution of the Sundarbans Biosphere Reserve as 'Biosphere District' in Phase I and in Phase IV in a manner that allows "the population below the green line starts to migrate to the newly developed areas" (Danda et al. 2011: 39–40).

During April–May 2010, the 'Vision Scenario' was discussed with at least 500 residents of the ISD at three different locations. It is important to note that only about 5 % of the participants felt that emigration option would work. The vast majority of respondents sounded rather pessimistic over the prospects of positive emigration. Looking at the wider experiences of involuntary or forced displacement, rehabilitation, and settlements in other parts of India, such a response was not surprising perhaps (Banerjee and Chaudhury 2005). The WWF Report still felt:

> The perception of how feasible the proposed scenario is could be markedly different if a carefully phased out, participatory capacity building and empowerment is pursued. *In such circumstances moving away from high-risk areas towards better opportunities may appear as the most attractive option for the younger section of the population.* Even in countries that have more economic resources than India, it is becoming clear that moving away from high-risk areas is and should be a preferable option. Hurricane Katrina and its aftermath in New Orleans, USA is a case in point (Ibid. 40). (Emphasis added)

In other words, the WWF Report seems to suggest that the *hope* for a more secure future, induced by empowerment and capacity building, and combined with the *fear* of losing control over steadily shrinking as well as fast degrading livelihood-resource base, might eventually convince the communities to move from high-risk to low or no-risk areas. Having noted that, there is no denying the fact that the overall resilience of the communities in the Sundarbans leaves much to be desired. As pointed out by DasGupta and Shaw (2015: 85), "the community resilience of 19 coastal administrative blocks of Indian Sundarbans were assessed" and "only one could be classified as high resilient block and the rest were found to be in low to moderate resilience categories. In general, the extreme coastal blocks were found to be less

resilient due to their high exposure & development deficit, however, at the same time, the study finds strong correlation of institutional interventions & effective coastal zone management in enhancing the overall resilience scores."

The recent World Bank Report titled '*Building Resilience for Sustainable Development of the Sundarbans: through Estuary Management, Poverty Reduction and Biodiversity Conservation*' (Sanchex-Triana, Paul, Ortolano and Ruitenebeek 2014) has also underlined the locational challenge faced by 4.4 million,[4] overwhelmingly poor, people inhabiting Sundarbans—a place ecologically important and unique but difficult to live in. The World Bank Report (cited hereafter as WB Report) strongly echoes the emphasis placed by all the contributors to this book on the need to acknowledge that there is complex physical and human geography to the issue of environmental sustainability. Whereas the overall contexts and general trends are no doubt extremely important, the specific locational attributes must be taken into due account while seeking innovative solutions to sustainable environments. According to the WB Report:

> *Many other coastal communities worldwide face development challenges that test the adaptive capacity of individuals, their social networks, the biophysical systems on which their livelihoods depend, and the institutions responsible for addressing these challenges. In the face of growing populations and declining carrying capacity of natural habitats, planning exercises for such communities are further compounded by uncertain future impacts of current unsustainable practices coupled with phenomena such as biodiversity loss and climate challenge. While there are many coastal communities facing such challenges, the Indian Sundarbans in the state of West Bengal provide an extreme case.* (Ibid.1) (Emphasis given)

The communities inhabiting the ISD, "find themselves geographically and socio-economically placed between two extraordinarily difficult contexts: the economic growth opportunities in nearby Kolkata, one of the largest conurbations of Asia, and the exceptional ecological values of one of the richest and most unique mangrove ecosystems in the world" (Ibid.).

The WB Study divides the ISD into three zones and designates them as: Core Zone, Transition Zone, and Stable Zone. The Core Zone comprises areas of the Sundarbans that are contiguous without human habitations and legally protected—the National Park, the Wildlife Sanctuaries, and the Reserve Forest. The Stable Zone is composed of relatively more stable parts of the delta, home to a number of established settlements, located further away from the mouths and tidal river courses, where "geomorphological processes are mainly involved with sedimentation and accretion (as opposed to erosion) enhancing the stable nature of the zone"[5] (Ibid.). Sandwiched between the Core Zone and the Stable Zone, situated along major tidal rivers and surrounding the forests, is the Transition Zone; "consisting primarily of rural communities with limited infrastructure and high levels of pov-

[4] Government of India Census 2011.

[5] The Stable Zone contains established settlements, both peri- and semi-urban environments, such as Bakkhali, Canning, Jayanagar-Majilpur, Kakdwip, Minakhan, Namkhana, Sagar Island, and Tengrabichi.

erty" (Ibid.). The so-called Transition Zone is the place characterized by risk, severe economic hardships,[6] everyday social struggles in search of a dignified life, and huge capacity deficit on the part of largely rural communities.

Why do these communities continue to live "in such a hostile living environment" of the Transit Zone and continue to decide against leaving such "challenging areas permanently"? (Ibid. 2) According to the WB Report, "people remain attached to their homeland and find themselves with limited abilities to pursue more attractive options. Only by improving their mobility through education, better health, and increased incomes would they have the personal capacity to pursue better and more promising opportunities in urban areas" (Ibid.).

The communities located in the Transit Zone—also situated between the logics of ecology/conservation and the logic of economics/consumption—continue to struggle to adapt to multiple transformations and dislocations, in the face of various top-down structural, managerial, and market-based solutions being vigorously pursued, and in some cases indiscriminately imposed from above, by the authorities concerned. Whereas a subaltern perspective reminds us of the fact that in cases where the dominant spatiality of 'social' remains deeply hierarchical and exploitative, the search for innovative solutions to environmental sustainability is likely to remain highly illusive in the absence of empowerment (social-cultural, political and economic) at the grassroots. Needless to say, social struggles demanding a genuine empowerment, one that is integral to the process of democratization, assume unprecedented importance, but face serious hurdles at the same time including "inadequate healthcare safety nets, poor infrastructure, mangrove destruction, impact of cyclones, reduced agricultural yields and unsustainable fisheries" (Ibid.14).

The policy recommendations made by the WB Report demand and deserve serious attention and early implementation. These goal-oriented recommendations belong to the overarching imperative of *collectively* building the resilience of the socio-economic and biophysical systems and fall in the following categories: (a) vulnerability reduction to ensure human survival; (b) poverty reduction to improve quality of life; (c) biodiversity conservation as a means to ensure broader long-term ecosystem functions and services as common public good; and (d) institutional change purposefully directed at the effective implementation of various recommendations by the institutions active in the Sundarbans (Ibid.).

I would like to conclude this section by citing briefly some of the key findings/lessons of the Non Lending Technical Assistance (NLTA) carried out by the World Bank. These findings reinforce the contention that the focus on future challenges of climate change need not—and should not—be at the cost of overlooking the current predicament of environmental unsustainability. According to the WB Report, "when

[6] According to the WB Report, "The findings of a household survey conducted as a part of this Non-Lending Technical Assistance (NLTA) indicate that, of a typical group of a thousand residents, 190 get only one day meal a day, for 60 of whom it will be a substandard meal. Of those thousand, 510 (mostly children) suffer from some form of malnutrition. If the sample came from the "richest' administrative block of the region, 310 of those thousand would still be below the poverty line; a sample in the poorest part of the region would see 650 of those thousand live below the poverty line." p. 1.

first conceived, this NLTA was framed in the language of climate change adaptation and biodiversity conservation, with a view to identifying the potential scenarios to support socioeconomic development under future uncertain conditions" (Ibid.). But, "after three years of research through 21 studies, the picture that emerged was quite different, as exemplified by the following lessons": (1) "The highest priority is not to address future uncertain impacts, but the very certain impacts of past events and current conditions that keep people trapped in poverty"; (2) "The role of future climate change adaptation is less urgent in comparison to current challenges, but climate change casts a long shadow over ongoing degradation of the resource base"; (3) "Blindly following a Business-As-Usual (BSU) development scenario will make matters worse because huge numbers of the residents of the Sundarbans will remain in harm's way…Interventions in the region need to maintain a careful balance so that a lifeline is extended to those currently under threat while ensuring that others are not placed at risk by encouraging in-migration"; (4) "The Sundarbans regions is not homogenous geographically or socioeconomically" and; (5) "Institutions are not yet equipped to address these issues coherently and comprehensively" (Ibid. 5).

The WB Report draws attention to a complex and compelling reality that stares in the face of millions of poor and the marginalized that are harmed by both the environmental injustices of the past and climate uncertainties of the future. The debate over which of the two categories of harm is more harmful is perhaps futile. But what would certainly benefit the poor communities in the Transit Zone of the Sundarbans is the acknowledgement by one and all that the threats faced by the present generation are as serious as the risks likely to be encountered by the future generation (Chaturvedi and Doyle 2015).

## 8.4 Zhangjiangkou 'Mangrove Forestry' 'National' 'Nature' 'Reserve': Planted Ecologies and Alienated Communities

It is useful in my view to begin with a brief overview of the overall state and status of coastal China before focusing sharply on a small but significant part of the coastal marine environment, namely Zhangjiangkou Mangrove Forestry, National Nature Reserve (to be cited hereafter as ZMNR). In 2008, the *Southern Metropolis Daily* brought out a report entitled "Dark Waters: Coastal China on the Brink" in two parts (*Southern Metropolis Daily* 2008a). Part one of report, commenting on the alarming decline of local fishing industry, said, "The seas are dying. China's coastline has become a massive dumping ground. The fish are vanishing; the water is becoming filthier by the day and the air is impossible to breathe. Areas that were once bustling and prosperous are now uninhabitable. The seaside towns of east China provinces of Jiangsu and Shandong are being deserted…the sea is becoming a danger zone" (Ibid.)

Whereas part two of the report focused on a number of chemical industrial zones and described how an industrial zone located along the Chao River forced the inhabitants of Duigou village, Gunnan county to carry on with their lives without a

proper environmental and social impact assessment (*Southern Metropolis Daily* 2008b). And when the Chao River turned 'red' due to severe contamination, the villagers protesting and demanding compensation "were sued for fraud by the management of the industrial zone" (Ibid.). It was pointed out in the report that, "it is not only sea life that is poisoned when waste from the land enters rivers and seas. Toxins are turning up on dinner tables through the salts extracted from seawater. Toxins may even end up back inside the bodies that produce them" (Ibid.).

Gao Zhiguo, then Head of the Maritime Development Strategy Research Institute at China's National Maritime Bureau, was reported to have said that, "The Bohai Gulf area is becoming one of China's three big economic regions… The environment there is coming under unprecedented pressure. Severe pollution in some regions is rapidly spreading to others. In some parts, there has been a total breakdown of the local ecology. The fishing industry has virtually run out of resources. Ecological disasters such as red tides and oil slicks are frequent" (Ibid.). It is important to bear in mind that fisheries and marine aquaculture in the Bohai Sea [a semi-enclosed sea with fragile ecosystems] not only provide seafood, but also sustain livelihoods of a large number of fishermen around the sea. All this is now under a serious threat due to fast degrading marine ecosystems, illegal fishing, and destructive fishing methods such as explosives and toxins. According to one analyst, "an estimated 43 of the 53 major waterways that run into Bohai are heavily polluted, with the worst conditions occurring near the mouths of the Yellow, Xiaoqing and Zhangwei rivers" (Liu 2007).

With a total area of about 2360 ha, ZMNR is located in Yunxiao, Fujian, China.[7] Sitting on the estuary of Zhangjiang river as well as named after it, the largest Avicennia marina forest in China (Chen et al. 2010) is home to 688 species of plants and animals and provides habitat and nursery sites for many commercially important fish and crustaceans. The mangrove forest plays important role in shoreline protection, chemical buffering, water quality maintenance, recreation, and education, besides acting as reservoirs of genetic materials. As pointed out by some experts, "During the past decades, the reserve and the area surrounded has been changed due to the environmental pollution problem, human activities, urbanization development, and other social/economic issues imposed on it, which brought on a series of responses of regional eco-environment and the variation of its ecosystem

[7] "Summary description: Fujian Zhangjiangkou National Mangrove Nature Reserve. 02/02/08; Fujian; 2358 ha; 23°552 N 117°252E). National Nature Reserve. Dominated by mangrove forest in the estuary area and including intertidal mudflats and salt marshes, located in the estuary of Zhangjian River. Due to high productivity, high decomposition and restitution rate, the mangrove coastal marsh and coastal arenaceous vegetation provides habitat for more than 154 birds species, including IUCN Red-listed species like Daimao (Eretmochelys imbricate), Lengpigui (Dermochelys coriacea), Xigui (Caretta caretta), Taipingyangligui (Lepidochelys olivacea), Huangzuibailu (Egretta eulophotes), andHeizuiou (Larus saundersi), as well as 240 other aquatic animal species and 224 vascular plants. It is also a spawning and breeding place for important fish species like Yicheng (Sinonovacula constricat), Banji (Clupanodom puncthatus), and Ziyu (Mugil cephalus). The site plays an important role in typhoon resistance, coastline protection, purifying water and maintenance of regional microclimate. Aquaculture is practiced here for local economic purposes." Source: Wetland International China.

See shttp://www.wetwonder.org/en/news_show.asp?id=476


**Fig. 8.2** Landscape of Zhuta village and Mangrove Forestry (photo by Sanjay Chaturvedi)

service values" (Zhang et al. 2009). For the local inhabitants, these wetlands are very important for wetland aquaculture. The human activities have been classified under four categories: picking seafood under mangrove, collecting seafood by couple in a boat, collecting seafood in both sides of public watercourse, and mudflat aquaculture (Fig. 8.2).

Communities living in the Zhuta village, in close proximity to ZMNR and depending on its resources, especially fishes, for their livelihood security feel alienated vis-à-vis what many would perceive as 'planted ecologies'. Tongchao (2006) has examined at length the relationship between the Zhangjiangkou Reserve and the adjacent community in the Zhuta village. In his view since the community economy relies upon the natural reserve resources, the perspectives of the villagers must be incorporated into decision-making and "the Nature Reserve should attract public participation to improve its sustainable development" (Ibid.). This does not appear to be the case as far as the inhabitants of village Zhuta are concerned (Fig. 8.3).

In the official discourse (as one official of the local forest department would describe to me), ZMNR is a site of conflict between the 'logic of ecology' and the 'logics of economy'. The impression that is conveyed through such a statement is that the local communities (perceived as located outside the 'nature', but expected to act as environmental stewards at the same time) are dictated more by the logic of economy/capital (making money) and much less, if at all, by the logic of ecology/preservation. Whereas the conversations with members of local coastal community reveal that there are several reasonings at play within the 'logic of capital' as well as the 'logic of ecology'. Many members of the local fishing community expressed


**Fig. 8.3** The author standing in front of the public display board describing the objectives and activities of "ZMNR" (photo by Sanjay Chaturvedi)


**Fig. 8.4** Fishfolk in Zhuta village (photo by Sanjay Chaturvedi)

a deep sense of dismay, bordering anger, on the time limits imposed on the fishing activity, their only source of income, by the local authorities (Fig. 8.4).

The coastal communities of ZMNR also find themselves at a considerable distance (physical as well as mental) both vis-à-vis the official-regulatory agencies and the mangrove site. They find the government agencies omnipresent, but at the

same time mostly invisible and thus largely inaccessible. Some in the village perceive the naming of the mangroves as 'Zhangjiangkou' National Nature Reserve after the river, and not after their village, as yet another evidence of its 'planted' nature.

Conversations with the local communities of Zhuta Village in Yunxiao County and Dongshan Port in Zhangzhou City of Fujian Province on the one hand, and the 'government officials' on the other, reveals a good deal of uncertainty, bordering confusion, over the nature, scope, and reach of 'governance' over the 'place' in question. The following insightful statement made by Shapiro (2012) appears to provide some explanation for this:

> There is fragmentation, both horizontal and vertical, in China's government structure. Competing and overlapping bureaucracies plague every level of administration, and the lines of authority from the "centre" in Beijing to the localities are often weak, with government officials at the prefecture, district, country and township levels often answering to other local officials rather than to their superiors in the central environmental bureaucracy. As a result there are competing perspectives on development and environment within the state, and differences of opinion as to how much attention to pay to the environment. Within the bureaucratic system there are strong advocates for a new, more ecological form of modernization, but they face serious challenges.

The NGOs like the China Mangrove Conservation Network (CMCN), while operating within the obvious constraints, hope to bridge the persisting gaps between the two estranged entities, namely multilayered authority and local communities; an uphill task indeed. My conversations with the young members of this NGO (mostly in their mid twenties), including its lead campaigner Liu Yi, revealed first and foremost their resolve to make a difference on the ground through education and awareness. A former student environmental group, established in 2000 at Xiamen University, turned into professional conservation organization; CMCN today has at least "40 cooperative nongovernmental entities (including NGOs, communities, schools, nature reserves and research institutions): 3000 volunteers; and 150,000 network members" (Yi 2008–2009: 76).

CMCN is committed to a conservation philosophy that is inclusive in its approach and rigorous in its outreach. It believes in addressing the core needs of all stakeholders and has been engaged in "campaigns that have been promoting research, encouraging mangrove rehabilitation and providing public education, community development and training to restore and sustainably use mangroves" (Ibid.75).

I was introduced for the first time to an excellent example of eco-social innovation at the micro level called the 'Duck Egg Model' (Ibid.) that was skillfully deployed by CMCN campaigners to reduce friction between the logic of ecology and logic of livelihood in the context of the wise and sustainable use of mangrove ecosystem services by the communities that depend on them for their livelihood security. A local delicacy of Fangchenggang in Guangxi Province is Red-heart salty duck egg that fetches three times the price than regular eggs due to its better taste and high nutritional value. Since mangroves, besides having a water cleansing function, play an important role in the production of this egg by providing a rich supply of seashells, fish, and shrimps, local fishermen remain deeply conscious of the fact that the carrying capacity of the mangrove must not be overstretched or overexploited

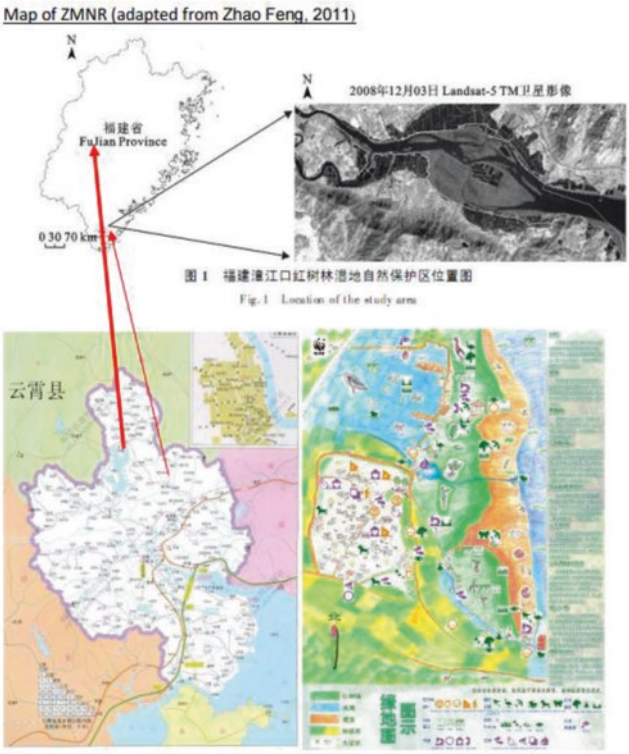


**Fig. 8.5** Zhangjiangkou Mangrove National Reserve Green Map (*source*: Beijing Forestry University (2011) "Preliminary Analysis of Demand for Eco-tourism at Zangjiangkow Mangrove Nature Reserve in the Fujian Province of China," http://www.itto.int/files/itto_project_db_input/2905/Technical/Consultant%20report%202%20-Preliminary%20Analysis.pdf)

by increasing the number of duck beyond a sustainable point in order to ensure the quality of eggs. Once the vital link between sustainable economy and a sustainable ecology is perceived and appreciated in this manner, the fishermen develop a stake in not only protecting the local mangroves, but also expanding their size.

CMCN is a good example of how the youth of China are forming associations and solidarities despite numerous odds, including the cumbersome registration process with the government and the daunting prospects of sudden closure (Shapiro 2012: 123). Making full use of the new media, these young activists are creating a new socio-spatial consciousness and new geographies of hope in rural China where even 'collective petitioning' carries risks. Only those relatively better off financially might be willing to take the risk (Chen 2012). It is worth pointing out that 'Zhangjiangkou Mangrove National Reserve Green Map',[8] based on data and information collected by CMCN over a period of 6 years, is not a 'map to scale' and this is where its key strength lies (Fig. 8.5).

[8] See www.greenmap.org/greenhouse/en/node/6874

This cartographic innovation is a kind of subtle subversion—which avoids outright confrontation with the party state and its multilayered 'governance' structure—of dominant official cartographies of 'natural reserves' that blatantly empty out ecosystems (terrestrial as well as marine) of their human component and social-cultural substance. The strategies adopted by CMCN draw attention to how environmental activism in China are "delicately dealing with political constraints, and in fact have been able to achieve their goals, maintain their autonomy, and convince the government of their intentions through non-contentious means" (Wu 2013: 112). The odds facing the micro-geopolitics of resistance in both China and India are enormous and include steadily unfolding dynamics and fallouts (social, environmental, and cultural) of the 'hegemony of transnational liberalism' and neoliberal globalization.

## 8.5 National Environmental Policies and Climate Action Plans of China and India: Peripheral Coastal Marine Environments

It is widely acknowledged by the climate earth science community, and emphatically reported by the IPCC (2007), that climate-induced sea level rise (SLR) will affect the coastal areas globally in a number of ways, including inundation, flood and storm surges, erosion, saltwater intrusion, and wetland loss. In case of India, some experts would anticipate SLR of 1 m as early as 2050, provided the West Antarctic ice sheet remained stable and ice streams from Greenland were not to accelerate (Byravan et al. (2012). According to the State Oceanic Administration (2010), "the sea level in February/October 2009 was higher than the 30-year average" with South China Sea measuring "the highest historical records in September 2009" (Cao et al. 2012: 65). It is anticipated that following provinces of China are going to be hard hit by the sea level rise and the corresponding seawater intrusion, salinization, and increase in storm surge hazards: Liaoning, Hebei, and Shandong provinces.

My intention in this section is to briefly examine the official responses of China and India to the challenge of environmental unsustainability and national action plans on climate change in order to ascertain the degree of importance they attach to coastal marine environments in general and mangrove forests in particular, especially in terms of mitigation, adaptation, climate justice, equity, and even loss and damage. A great deal has already been said and written about how climate change is going to impact China and India and how the two governments have responded so far in terms of both national action plans and international diplomacy (Rastogi 2011; Zang 2009; Lewis 2009; Urban 2009; Yagi 2011; Danny 2010; Lo 2010; Morton 2008; Xiong et al. 2007). In the wake of recently held CoP 21 in Paris under the UNFCCC framework, experts in China and India have been busy analyzing the implications of Intended Nationally Determined Contributions (INDCs) for the two major stakeholder and players in climate diplomacy.

The 2006 National Environmental Policy of India (MOEF 2006) lists the following elements as central to the national response to global warming: adherence to the principle of common but differentiated responsibilities and respective capabilities; prioritization of the right to development; belief in equal per capita entitlements to all countries to global environmental resources; reliance on multilateral approaches; and participation in voluntary partnerships consistent with the UN Framework Convention on Climate Change (UNFCCC). China's 2007 National Climate Change Programme (PRC 2007) mentions in its foreword: "Climate change is a major global issue of common concern to the international community. It is an issue involving both environment and development, but it is ultimately an issue of development. As noted by the *United Nations Framework Convention on Climate Change* …the largest share of historical and current global emissions of greenhouse gases has originated from developed countries, while per capita emissions in developing countries are still relatively low and the share of global emissions originating from developing countries will grow to meet their social and development needs" (Ibid. 2).

China's Climate Change Action Plan (Sect. 4.2.4) deals with 'coastal zones and coastal regions' in the context of climate change mitigation and adaptation. It underlines the importance of "establishing and improving relevant laws, regional management regulations and detailed rules in accordance with Marine Environment Protection Law of the People's Republic of China, Law of the People's Republic of China on Administration of Sea Areas, keeping in mind the characteristics of the specific localities in the coastal areas" (Ibid. 52). The importance of putting into place integrated coastal zone management (ICZM) system, the comprehensive decision-making mechanism, and effective coordination mechanism is duly highlighted along with technology development and extension. The Program underlines the need to "strengthen research and development of technologies for protection and restoration of the marine ecosystems, with emphasis on cultivation, transplanting, and recovery of coastal mangroves, protection and restoration of coral reefs and coastal wetlands to reduce the vulnerability of ecosystems in coastal zones" (Ibid.). We are further told that it is important to "accelerate the construction of the designated marine natural reserves, such as coral reef reserves, mangrove reserves," and "improve capability of protection of marine biodiversity" (Ibid.).

The 2010 Report of State Oceanic Administration entitled, 'Coastal Economic Zones: Responses to Sea Level Rise and Adaptation', reaffirmed the central importance of coastal regions in the overall economic development and prosperity of China. It acknowledged that whereas coastal zones hold key to sustainable development of the key sectors of Chinese economy, mapping differentials among them in terms of coastal erosion, saltwater intrusion, and soil salinization due to sea level rise and other natural disasters is important but quite challenging. The report proposed the following (*reproduced verbatim*) in order to "effectively reduce the impact of rising sea levels":

– Local governments in coastal zones should attach importance to the impact of rising sea levels at all administrative levels, strengthen investigations into the impact of sea level rise, control the impact of sea level rise based on the regional

setting, and formulate development plans in the region that take full account of the impacts of sea level rise.
- Key economic zones in coastal areas should carry out sea level rise impact assessments, vulnerability assessments, and area zoning projects. These will be important indicators for the planning of key economic zones in coastal areas.
- In the Liaoning Coastal Economic Zone, the Caofeidian Industry Zone, and Yellow River Delta Ecological Zone, great attention should be paid to seawater intrusion and soil salinization. Reasonable allocation of water resources, irrigation facilities, planning of marine aquaculture areas to mitigate sea level rise, and the impact of seawater intrusion should be carried out.
- The Tianjin Binhai New Area, the economically developed Yangtze River Delta and the Pearl River Delta, should be strictly planned. Building height and groundwater exploitation have to be controlled for effective mitigation of land subsidence and reduction of the relative sea level rise.
- For the Pearl River Estuary, the Yangtze River Estuary, and other areas that would be affected by serious seawater intrusion, water resources in the entire basin should be allocated reasonably in order to reduce the impacts of seawater intrusion and guarantee water supply during the dry season.
- Coastal areas in the provinces Zhejiang, Fujian, Guangdong, and Hainan should monitor riptides and typhoon landing sites during the high sea level seasons. Early warning systems should be included in the disaster prevention and mitigation plans. The role of sea level rise in natural hazards has to be fully taken into account in order to reduce the extent of storm surge hazards.
- Results of monitoring and forecasting of sea level rise have to be used in order to revise the standard installations of embankments and sewers.
- In coastal wetlands, mangrove swamps, and other coastal marine protected areas, a coastal network across all ecosystems should be established in order to reduce sea level rise caused by coastal erosion (cited in Ibid. 61).

What appears to be missing by and large in the above mentioned, undoubtedly important, recommendation is the ‘social’. The problems and priorities facing coastal communities, whose livelihoods depend on eco-services provided by mangrove reserves, are conspicuous by their absence. The focus and emphasis here is overwhelmingly on mitigation and there is no mention whatsoever of community-centric adaptation.

More recently, a new discourse of China’s aiming at the status of a ‘maritime power’ has come into play (Li 2013). The official manifestation of this course can be seen in the restructuring plan officially announced on 10 March 2013, which will bring its so-called ‘Five Dragons’ (the five maritime law enforcement agencies: the Maritime Surveillance of the State Oceanic Administration, the Coast Guard of the Public Security Ministry, the Maritime Safety Administration of the Transport Ministry, the Fisheries Law Enforcement Command of the Agriculture Ministry, and the Maritime Anti-Smuggling Policy of the General Administration of Customs) under the control of the new Oceanic Administration.

The release of India's National Action Plan on Climate Change (NAPCC) in 2008 by the then Prime Minister Manmohan Singh was widely seen as a turning point in India's engagement with climate change (Government of India 2008a). While prioritizing India's development imperatives, the NAPCC, for the first time, established a concrete framework to address climate in the domestic context. The NAPCC is a package of measures addressing both mitigation and adaptation and includes eight national 'missions' for solar energy, energy efficiency, water conservation, more public transport, sustainable agriculture, sustaining the Himalayas, and scientific research. Whereas a good deal of emphasis has been rightly placed on sustaining the Himalayan ecosystems (where glaciers are a major source of India's water supplies), policies systematically aiming at sustaining coastal marine environments in the Bay of Bengal are yet to be implemented fully.

This is not to suggest that India has completely neglected the economic and ecological importance of mangroves, along with other coastal resources like coral reefs and coastal forests. In the National Strategy and Action Plan (NSAP), entitled 'Mangroves for the Future' (Government of India 2008b), there is an explicit acknowledgment of the threats to marine ecosystems that come from wide ranging sources including polluting industries and settlements and their haphazard locations, overexploitation of living natural resources, and more importantly (but also more recently) "inadequate institutional capacity for, and participation of local communities in formulation and implementation of coastal management plans" (Ibid. 18). At the same time, there is no dearth of acts/policies and programs within India's existing policy and legal framework of 'coastal and marine ecosystems'.[9] In the context of climate change, the NSAP does point out, however, that, "climate Change and its impact on coastal regions of India are little known" (Ibid. 41).

One of the key issue-areas identified in the NSAP relates to coastal livelihood and peoples' participation in sustainable marine environments. According to the NSAP:

> Peoples' participation is extremely important in conservation and management of coastal resources. Realizing this, almost all States of India have initiated Joint Forest Management (JFM) activities in conservation and management of their coastal ecosystems. No decision-making is complete without participation of local people whose livelihood depends on wetland resources. People have been using mangrove areas in a traditional manner since times immemorial. Both traditional and latest scientific technologies need to be blended to achieve long-term conservation goals. Participatory Rural Appraisal (PRA) involving local

[9] See Ibid. p. 20. The list of 26 Acts/Policies and Programs includes 1882 India Forest Act, 1897 Indian Fisheries Act, 1908 Indian Ports Act, 1950 Coast Guard Act, 1958 Merchant Shipping Act, 1972 Wildlife Protection Act, 1974 Water (Prevention and Control of Pollution), 1976 Maritime Zones Act, 1978 Marine Fishing Regulation Act, 1980 Forest Conservation Act, 1982 Coastal Pollution Control Series, 1986 Environmental Protection Act (EPA), 1991 Costal Regulation Zone Notification (under EPA 1986), 1991 Coastal Ocean Monitoring and Prediction System, 1995 National Environment Tribunal Act, 1995 UNCLOS, 1996 Coastal Zone Management Plans, 1997 National Environment Appellate Authority Act, 1998 Integrated Coastal and Marine Area Management Project, 1998 Ocean Observation and Information Services, 1998 Turtle Excluder Device, 1998 DOD Program on Assessing Marine Life beyond 70 m depth, 2002 The Biodiversity Act, 2004 Swaminathan Review Committee on CRZ Notification 1991, 2006 National Environment Policy and 2007 Draft National Biodiversity Action Plan.

> communities should be the main approach to ensuring community participation. This approach should also take into consideration issues of gender sensitization and involve women in the management of issues (Government of India 2008b: 35–36).

The insights provided by Steinberg (1999) cast some useful perspectives on national action plans of China and India on climate change mitigation and adaptation, especially with regard to coastal marine environment. According to Steinberg, the marine environment, including the ocean, "is not simply an environment wherein distinct marine phenomena may be observed by marine specialists (i.e. marine geographers). Rather it is a space that, like land, shapes and is shaped by, a host of physical and social processes" (Ibid. 367). Steinberg therefore underlines the importance of taking into account "the geography of *ocean-space*, a term that captures both the specificity of the world oceans and the fluidity between the study of landward and seaward domains" (Ibid.) Both are "socially and physically constructed through linked dynamics" (Ibid.). A nuanced understanding of coastal marine environments, along the lines suggested by Steinberg, seems to be missing in the official policies of China and India with regard to climate change mitigation and adaptation by the coastal communities.

At the 21st Conference of the Parties (CoP 21) to the UNFCCC, held in Paris in December 2015, both China and India submitted under their respective 'Intended Nationally Determined Contributions' (INDCs). China's INDC document underlines China's resolve to implement the National Program on Climate Change (2014–2020) in a proactive manner by improving both national and regional strategies—with greater emphasis placed on urban in comparison to rural—on climate change. In the context of Low-Carbon Energy System, it also makes a reference to China's plans to "develop hydro power, on the premise of ecological and environmental protection and inhabitant resettlement" (Ibid. 7).

China's INDC does refer to coastal marine environments while talking about 'increasing carbon sinks' (Government of PRC 2015). It talks about China's resolve "To strengthen the protections and restoration of wetlands and to increase carbon storage capacity of wetlands" under the sub-heading 'Increasing Carbon Sinks' (Ibid. 10). Under the sub-heading 'Enhancing Overall Climate Resilience', it underlines the need "To enhance resistance to marine disasters and management of coastal zones and to improve the resilience of coastal areas [conspicuous by its absence is the reference to coastal communities and their social-economic resilience] against climatic disasters". It is instructive to note that the Chinese INDC emphasizes the need to "build on carbon trading pilots, steadily implementing a nationwide carbon emission trading system and gradually establishing the carbon emission trading mechanism so as to make the market play the decisive role in resource allocation" (Ibid. 14). The Chinese submission also refers to the need to "ensure openness, fairness and justice in the operation of the carbon trading market" (Ibid.). Overall, in China's INDC document there are a few important references to the 'coastal marine' dimension of China's intended national contributions to climate mitigation and adaptation, but the human-social dimension largely in the background and untouched. There is also a reference to the 'principle of common but differentiated responsibil-

ity'; a longstanding principle in climate diplomacy that now stands somewhat diluted under the Paris agreement (Saran 2015).

The imprint of social and cultural on India's INDC (Government of India 2015), carrying the sub-title 'Working Towards Climate Justice', is far more visible and pronounced. The latter opens with a quotation from the *Yajur* Veda: "Unto Heaven be Peace, Unto the sky and the Earth be Peace, Peace be unto the Water, Unto the Herbs and Trees be Peace" (Ibid. 1) and points out that "Environmental sustainability, which involves both intra-generational and inter-generational equity, has been the approach of Indians for very long" (Ibid.). Similar to China's INDC, it mentions the principle of 'common but differentiated responsibility' and highlights the fact that "even now, when the per capita emissions of many developed countries vary between 7 to 15 metric tonnes, the per capita emissions in India were only about 1.56 metric tonnes in 2010" (Ibid.). It further points out "wide disparities amongst it people and regions" along with the facts that "around 363 million (30 % of the population) live in poverty, about 1.77 million people are houseless and 4.9 of the populations (aged 15 and above) are unemployed" (Ibid. 4). It goes to the credit of India's INDC that it talks at some length about 'coastal regions and islands' in the context of climate adaptation. There is a reference to the setting up of Coastal Regulation Zone (CRZ) in "demarcated vulnerable areas on the coasts" and imposition of restrictions on "setting up and expansion of industries, operations and processes in these areas" (Ibid. 22). It also mentions that India is implementing programs for Integrated Coastal Zone Management and the vision is to "build national capacity for implementation of comprehensive coastal management through ecological management, conservation and protection of critical habitats, coastal geomorphology and geology of coastal and marine areas, coastal engineering, socio-economic aspects, policy and legal issues and other related fields in the area of coastal governance" (Ibid. 23). We are also told that, "another initiative to protect coastal livelihood is 'Mangroves for the Future 'Mangroves for the Future (MFF)' coordinated by International Union for Conservation of Nature (IUCN) in India" (Ibid.). The focus on coastal marine environments in India's INDC remains overwhelmingly national and occasionally local. Conspicuous by its absence is the reference to regional scale, which assumes extraordinary significance in the case of Sundarbans shared by India and Bangladesh.

## 8.6 Social Struggles, Resistance, and Social Innovation: Prospects in China and India

The twenty-first century has been variously termed as the 'Asian Century' or 'Climate Century' or 'New American Century'. This author and Painter have argued that there is sufficient evidence to suggest that what is also unfolding before us is a century of resistance marked by a number of silent, even invisible, revolutions, demanding social justice and equity (Chaturvedi and Painter 2007). What kind of future beckons the communities inhabiting the ISD and ZMNR in the era of climate change and scarcities is difficult to predict. What does appear steadily unfolding on

the horizon is more vociferous resistance at the grassroots level, grounded in contentious politics, against the discourse of 'global governance' on the one hand, and the dominant state-centric imaginations and representation of the '*marine environments*' on the other. Inherent in both is the tendency to downplay the experiences and perspectives of local communities. A territorialized representation of coastal marine environments results in a rhetoric of sustainability that remains prisoner of 'national' scale. On the other hand, visualizing marine environments as fluid, multi-dimensional spaces, formed by the ongoing multi-scalar linkages and interactions among states, civil societies, and ecosystems, opens up new spaces for bottom-up approaches to environmental sustainability through social innovations anchored in social justice.

I have no intention whatsoever of privileging one scale over the other for the purposes of this chapter. I would also sound a note of caution against invoking a clash of scales that inhibits innovative, proactive, and holistic responses to sustainable environments and climate change. A multi-scalar, overlapping, and fluid *spatiality* of climate change cannot be captured by the classical, fixed geographical scale, with neatly marked aggregated levels ranging from 'local' to 'global'. The proverbial billion-dollar question that still remains largely unanswered and that I would like to address in the analysis that follows is this: what are the prospects of alienated and marginalized coastal communities in China and India 'jumping the scale' in order to invite regional and global attention and strategic visibility? Does the world-renowned Chipko movement of 1970s waged and 'won' in the Garhwal Himalayas, and its more recent avatars, provide some hope if not an answer?

Before moving forward to answer the questions raised above, I would like to make a passing reference to a statement attributed in a blog on *chinadialogue* to Ma Zhong, Director, Department of Environmental Studies, Renmin University, that, "agitated street protests must develop into social movements that actually effect real reforms, not just knee-jerk reactions". We are further told that, "Among present environmental movements in China, another question that deserves reflection is the distribution of public and private matters. In the "mass incidents" that have already happened, it's easy to see that people take care of issues that affect their homes and personal lives, but with regard to other issues, there is an obvious gap in public concern" (Nan and Chun 2013).

## 8.7 Micro-Geopolitics of Resistance and Environmental Sustainability: Revisiting the 'Chipko' in Retrospect and Prospects

What is unfolding in both India and China today is a micro-geopolitics of resistance against the nexus between the neo-liberal, market-driven global warming discourses and state-centric national climate action plans which tend to push into oblivion the long-standing histories of environmental destruction and injustices. A number of

social-spatial strategies of resistance are being deployed by communities located on the margins, against the maps of meaning forcibly imposed on their embedded localities and highly vulnerable political economy of life and livelihoods. In contemporary China, as Elizabeth C. Economy (2004: 252) points out, "social discontent is evident everywhere. It is expressed in forms as diverse as labor unrest, mounting peasant protest, and increased ethnic violence. As the government has diminished its role in guiding the economy, its role in managing society has decreased as well…It is this discontent, if mobilized throughout the country and more specifically directed at the Communist party, that Chinese authorities fear."

The number of protests and petitions with regard to environmental issues (especially water and air pollution) in China is increasing with each passing day (Nan and Chun 2013). The everyday struggles and protests, while drawing upon the civilizational ethos and philosophical traditions of China and India, symbolize what Sheth (2004) has described as micro movements in favour of participatory democracy; "a parallel politics of social action, creating and maintaining new spaces for decision-making (i.e. for self-governance) by people on matters affecting their lives directly" (Ibid. 56). In his view, "the micro-movements in India represent a varied and complex phenomenon. They are variously referred to as 'grass roots movements', social movements, non-party political formations, social-action groups and movement-groups" (Ibid). What they seem to share in common, despite various differences in terms of scope and emphasis, is the firm resolve to oppose the post-political push of market-driven climate change mitigation and adaptation strategies. It is equally noteworthy that,

> Although the movements usually work in local areas they invariably define local issues in trans-local terms. Theirs is thus a new kind of local politics which, unlike the conventional politics of local governments, is not linked vertically to the macro structures of power and ideology, either of a nation state or of the global order; nor is this politics parochially local. It expands horizontally through several micro-movements of people living in different geographical areas and socio-cultural milieus, but experiencing the common situation of disempowerment caused by mal-development and contemporary forms of governance which are imperiously distant, yet close enough to feel their coercive edge (Ibid.).

The Chipko movement, from one important perspective, has been described as "the result of decentralized and locally autonomous movements" (Ekins 1992: 1430). Imaginatively waged, the Chipko *Andolan* (movement), dexterously drawing upon a mix of design and spontaneity, is an inspiring example of social innovation offering both local dividends and universal appeal. It reminds us that innovation in general and social innovation in particular need not (and should not) be taken as an end by itself. On the contrary, innovation is means to realize certain concrete goals or objectives and there may be winners and losers in a particular instance of innovation.

It was on June 24, 1973 that the first non-violent act of resistance was directed against the forest felling undertaken by the rich contractors from the plains in the Mandal forests. A far more "vociferous yet non-violent resistance at the Reni forest was triggered off by the news of auction of some local forests for felling to a sports-goods company from the plains" (Bandyopadhyay 1999: 880). The philosophy and

poetics of Chipko is graphically illustrated in the following lines written by the folk-poet of the movement, Ghanshyam Raturi:

> Embrace the trees in the forests
> And Save them from being felled!
> Save the treasure of our mountains from being looted away from us (cited in Ibid.)

At a later date and at a different site (the Doon Valley), he elaborated the local, but at the same time, trans-local, philosophical ethos of the micro-geopolitics of resistance in the following words (note the deep meaning behind the symbol of hugging):

> A fight for truth has begun at Sinsyaru Khala
> A fight for rights has begun in Mulkot Thano Sister
> It is a fight to protect our mountains and forests
> They give us life
> Hug the life of the living trees and streams to your hearts
> Resist the digging of mountains that kills our forests and our streams
> A fight for life has begun at Sinsyuru Khala

The ecological turn of Chipko thus came a bit later and was captured succinctly by Bahuguna in his contention that, "ecology is permanent economy". It was this message in particular that he would spread all along the trail of his historical 5000 km foot march, which eminently qualifies in my view an excellent example of social innovation, used to rejuvenate the long-standing tradition of resistance in this part of Indian Himalayas. On the occasion of receiving the Right to Livelihood Award on 9 December 1987, Mr. Bahuguna said,

> It must be admitted that to begin with Chipko was an economic movement and we looked upon forests as a source of employment through tree felling and providing raw material for industries. The long suffering of hill women have guided the activists to reach new heights in their movement, when these preserving mothers of the future generations dictated that forests were their maternal homes, which provided water, food, fodder and fuel. Both the trees and mothers teach that to live and also to be ready to die for the sake of others proves to be the real fountain of bliss. Thus came the famous slogan: What do the forests bear? Soil, water and pure air; soil, water and pure air are the basis of life.

The Chipko has been a victim of its own success in the sense of 'floated myths and flouted realities' (Bandyopadhyay 1999). In response to the question related to the key driving factors and forces behind the Chipko movement, Bandyopadhyay has persuasively argued and illustrated that it was neither a movement guided by the "ideas of deep ecology", nor a "feminist movement based on gender conflicts". The movement, argues Bandyopadhyay, "got its initial start in the conflicts over mountain forests between the economic interests of the mountain communities and the economies of the plains. However, this fundamental basis of the movement got substantially reduced with the contract system of felling being stopped and the establishment of the public sector Forest Development Corporation. The feelings were then onwards undertaken with the help of local village cooperatives (Ibid. 880)."

Most of the discussion that has taken place on the issue of roots and routes of Chipko has failed to acknowledge the seminal contributions of two visionary European disciples of Mahatma Gandhi: Mira Behn (Madeleine Slade) and Sarala

Behn. Mira Behn could sense early on that the forces of commercial forestry were up against the livelihood economy in the Himalayas and wrote in 1952:

> Year after year the floods in the North of India seem to be getting worse, and this year they have been absolutely devastating. This means that there is something radically wrong in the Himalayas, and that something is, without doubt, connected with the forests. It is not, I believe just a matter of deforestation as some people think, but largely a matter of change of species…The Banj [Himalayan Oak] brings them no cash for the coffers, whereas the Chir pine is very profitable, yielding as it does both timber and resins (Mira Behn 1950).

Whereas Sarla Behn, highly regarded as the 'Daughter of the Himalayas', was at the forefront of anti-alcohol movement and vociferously critical of the centralized governments. She argued that, "the principles that govern humanity are higher than those that govern the state…a centralized government, indifferent to its people, is a joke" (Sarla Behn).

It needs to be acknowledged that the real strength of the Chipko movement has been that it has served as a catalyst and source of inspiration for various micro social struggles in different parts of India. One outstanding example of this is the Appiko movement. To quote Pandurang Hegde, the leader of this movement, "Like a migratory bird the Chipko Ideology traversed 2500 km from the Himalayas crossing the central India and roots on the west coast in the Western Ghats in South India. It got a different name with the same tone known as Appiko (Meaning hug the trees in Kannada language) Andolan."[10] The key guiding principles of Appiko are *Ulisu* (to save), *Belasu* (to grow), and *Balasu* (rational use of forest resources). Of central value to Appiko philosophy of conservation are the five species: frit, fodder, fuel wood, fertilizer, and fibre.

The Western Ghats (or Sahyadri mountain range along the west coast of India), catchments of major rivers that provide irrigation to thousands of hectares in the Deccan plains, is not only well-known for tropical forests and numeric endemic species of flora and fauna, it is considered as one of the 18 biodiversity hotspots in the world. The local agriculture economy has been under the assault of large-scale eucalypts plantations in order to meet the commercial revenue of the state. The tremendous loss of biodiversity as well as the tree cover have resulted in the drying up of the water sources and caused scarcity of biomass for agricultural inputs. The local communities were deeply concerned about their steadily dwindling agricultural yields and depleting forests.

The genesis of the Appiko can be traced back to protest registered by the Youth Club in Balegadde village of Sirsi taluka (Uttara Kannada district in Karnataka) against the clear felling of natural growth forest in order to pave way for teak plantations. The response of the forest department was that its action was a "part of the scientific forestry policy of state government". Aware of the Chipko struggle and its outcome, the villagers decided to invite Sunderlal Bahuguna to their village. After marching to the forests that had been marked for clear felling by the forest department, the villagers took a vow to protect the forests by non-violent Chipko Movement or known locally in Kannada language as Appiko—meaning hug the trees. The Appiko *Andolan* or Movement was thus launched in Kelase forest, near Salkani village on 8 September

[10] Pandurang Hegde, in correspondence with the author, 26 October 2012.

1983. According to Hegde, "The Appiko Movement uses various techniques to raise awareness: foot marches in the interior forests, slide shows, folk dances, street plays and so on" (Hegde 1989).

As mentioned above, to begin with, the Appiko Movement's goal was to halt the clear felling of natural forests and conversion to monoculture plantations, which came to be perceived by the local forest authorities as a threat to the government policy. Despite all possible moves made by the government officials to arrest the further spread of the movement, the "hidden hardships of the people and the conflict over the natural resources" acted as powerful catalyst for taking the movement to various parts of Karnataka. As Hegde puts it, "The thrust of the Appiko Movement in carrying out its work reveals the constructive phase of people's movement. Through this constructive phase, depleted natural resources can be rebuilt. This process promotes sharing of resources in an egalitarian way, helping the forest dwellers. The movement's aim is to establish a harmonious relationship between people and nature, to redefine the term development so that ecological movements today form a basis for sustainable, permanent economy in the future" (Ibid.).

Well-organized grass roots actions over a decade and pressure from a number of groups forced the state government to change the forest policy. In 1989, a ban on felling of green trees in the natural forests was imposed by the state government, which continues till today. In the meanwhile, new threats to livelihood security of communities living on the margins in India have emerged. In the last week of December 2012, a series of protests unfolded in Kumta, a coastal town in Karnataka, against the proposed expansion of four-lane highway along the West Coast. They would not allow the public hearing to take place because they felt that the 'space' was not large enough to allow a large number of protesters to gather and protest. Hegde reported and analyzed the popular protest as follows: "The people were up in their arms against the large infrastructure project that would destroy their livelihoods. Ironically most of them, even the lawyers who were leading them were not aware that a day before the public hearing the cabinet had passed the formation of the National Investment Board (NIB) or Cabinet Committee on Investment (CCI). This had sealed the fate of four lakh people in the 190 km stretch on the fragile west coast. The proposed project if implemented would violate the Forest Conservation Act and Wild Life Conservation Act. Nevertheless, the CCI, as the supreme body had been vested with powers to over-rule these violations and grant permission to implement the project" (Hegde 2012). What are the prospects of this resistance?

Hegde in his communication with this author[11] has raised a number of key questions in the Indian context that, in my view, are relevant to some extent for China. He wonders whether the movements such as Appiko lost their relevance and would eventually fizzle out due to factors such as the absence of a second line leadership? To quote him, "Has it [Appiko] become a legend that is incorporated in text books in schools rather than to be followed in everyday life?" He goes to ask, how conducive is the current social situation in India to launch movement of any kind for public good? What are the implications of excessive role of media, consumer culture, and

[11] Pandurang Hegde in correspondence/conversation with the author through email. 26 October 2012.

attraction of urban way of living for social struggles aiming at innovation? According to him, "Even though the ban stays on felling of green trees in the natural forests, there are big projects like hydel dams, railway lines and mining which are taking a toll on natural forests" (Ibid.).

## 8.8 From Chipko to Appiko to Climate Change: Resisting the Politics of Post-political

In the era of climate change, the geopolitics of sustainability has increasingly acquired a complex and convoluted character. The post-structural climate change metanarrative and its various strands, including 'green carbon economy', tends to push the highly contentious domain of sustainability into a post-political phase. In such a context where the distinction between the perpetrator/polluter and the victim is made to simply evaporate in the thin air, it becomes far more difficult to conceive, launch, lead, and sustain a movement like Chipko precisely at a time when such movements are most needed from the standpoint of the marginalized.

Gupta (2008) in his thoughtfully entitled paper, 'From Chipko to Climate Change' has raised a number of issues that are worth engaging with. His key argument is that "few mountain communities remain untouched by the influence of globalization" (Ibid.). The village of Jardhar in Garhwal is a revealing example of how "the global conservation ethic and global development are, in certain circumstances, detrimental to local interests: they transfer costs from power urban centers and demand sacrifices from fragile mountain communities" (Ibid. 4). Some of the leading but relatively unknown figures of Chipko movement like Dhum Singh Negi have been involved with *Beej Bachao Andolan* (Save the Seeds Movement), which resists the government-sponsored schemes to spread the Green Revolution in the mountains in order to "increase food availability in cities and to keep food prices low" (Ibid. 6). The net result is that the community that once had over 80 varieties of rice and over 200 kinds of beans stands split as some local farmers, lured by the prospects of higher and faster yields, opted for hybrid seed varieties of rice. Abandoning subsistence ecology in favor of commodity production has widerranging implications for agricultural sustainability based on seed preservation, compost, and crop diversity (Ibid.). Vijay Jardhari (a leading voice of the *Beej Bachao Andolan*) would argue: "A farmer's independence can only be ensured if he keeps his own seed, otherwise he is just a slave of the company or the government. What kind of new seeds are these that cannot be kept for the next crop?" (Ibid.6).

According to Gupta, "The power of global environmental discourse is pervasive and operates at several levels. It influences national governments to formulate policies that are often insensitive to fragile rural ecologies; it also conditions the arguments of local movements" (Ibid.). His statement that "Chipko echoed the global green agenda of the 1970s and 1980s, specifically that of conservation of forests and wildlife" (Ibid.) needs to be tempered with the realization that Chipko was a locally embedded movement with a trans-local vision that questioned the imposition of a

particular dominant view of 'development' that was fast becoming the metanarrative of sustainable development. Gupta's contention however that "*Beej Bachao Andolan* reflects the global emphasis on biodiversity of the 1990s" is spot on along with his argument that, "In the 21st century, as climate change takes center stage in the global environment debate, forests—in order to fulfill their 'carbon sink' function—could be made even more inaccessible. Again, it is local communities like Jardhar that will be the vanguard of a revolution not of their making" (Ibid.).

I would like to expand the scope of Gupta's argument by saying that along with the forests, the water bodies (the seas, rivers, estuaries, mangrove forests, etc.), in order to fulfill their 'blue carbon sink' as well as 'carbon trading' functions (Yee 2010), too might become increasingly inaccessible to those who depend on them for their livelihoods, and this includes millions in both China and India. The highly seductive appeal of such framings, narratives, and discourses lies precisely in their reductionism; the ability to transform complex processes and phenomena at the local scales into abstract 'manageable' categories at the service of national action plans and regional and global agencies.

It is reasonable therefore to at least envisage the migratory bird of Chipko landing on the coastal areas to resist new forms of domination, discriminations, and destructions in various parts of the global south and beyond. While looking for such examples (and eventually finding one thanks to Kurien), I came across the following insightful remark by Scott in his book *Weapons of the Weak: Everyday Forms of Peasant Resistance*: "Most subordinate classes throughout most of history have been rarely afforded the luxury of open organized political activity. But as fast as millions of anthozan polyps create willy-nilly a coral reef, so the multitude of peasant insubordination and evasion create barrier reef of their own" (Scott 1985).

Kurien has found a good example in the Indian state of Kerala, in India, "where small-scale, community-based fisherfolk initiated collective action to invest in rejuvenating the natural assets of the sea that had been destroyed by the incessant fishing operations of large-scale bottom trawlers in the region" (Kurien 2004: 1). The strategy they chose to resist commercial fishing is literally the same as metaphorically stated by Scott. What they actually did was to erect artificial reefs at the sea bottom in coastal waters. By creating anthropogenic marine environments, the fisherfolk created a space in which to exercise power of protest in support of their livelihood security. Whereas the multi-purpose artificial reefs, strategically positioned in the coastal waters, can in due course of time enrich the overall biomass and rejuvenate the fish stock in the local ecosystem.

> A unintended side-effect of sufficiently large artificial reefs is that they act as barriers to the operation of bottom trawl nets, effectively performing the role of a sea bottom fence against incursions of trawlers into coastal waters. Such reefs have not yet healed the wounds inflicted on the coastal ecosystem of the area, nor can the fishing communities depend exclusively on them as a major source of livelihood. But such community investments by small-scale fisherfolk, and their appropriation of coastal sea area to form community property rights, point to the potential for strategies for visualizing natural resources in a new light—as natural assets that can contribute significantly to sustainable resource use, community empowerment, and well-being. Only with such strategies can we have the blessing of the commons (Ibid.).

Revisiting Chipko in retrospect and prospects is useful also in the sense that it reminds us of the compelling fact that in Global South, including China and India, it is neither feasible nor desirable to approach and analyze climate change issues in isolation. These issues are intractably intertwined with environmental and social justice issues. As Haas (2008:3) puts it so insightfully, "the nearly 20 years of persistent negotiations on the climate change regime have had significant second-order displacement effects on environmental governance more generally. They have diverted attention away from other possibly pressing problems, crowding out issues such as ecosystem decay, or Third World water quality. They have unnecessarily elevated "cooperation" to the status of an end rather than a means to environmental protection. Scarce political capital has been channeled into trying to build a constituency for climate change policies and domestic enforcement."

## 8.9 Towards Chinese 'Chipkos': Imagining the Unthinkable?

In a recent scholarly study focusing 'the struggle for sustainability in rural China', Tilt has provided a detailed account of how villagers in the Futian village, while silently drawing upon "China's historical legacy of civic dissent—grounded in millennia-old concepts such as the mandate of heaven and solidified in mass movements such as the Cultural Revolution" (Tilt 2010), have skillfully initiated and sustained their protests against damages to their health, local environment, and economic livelihoods. They have been ably assisted in their struggles by the "growing body of civil law that increasingly affords legal standing to individuals" (Ibid.). Tilt refers to the argument made by some scholars that what Chinese society is experiencing today is more of 'dynamic environmentalism', which falls quite short of 'environmental movement'. I agree with Tilt's argument that,

> While there may be a certain truth to it, this conclusion does little more than raise a more difficult question: What's in a movement? If we adjust our scholarly lens to see only those movements that are formal and institutionalized, China indeed appears to lack a cogent environmental movement. But this overlooks the subtle, spontaneous, ad hoc collectivities that cohere around shared interests regarding environmental problems. In fact these sorts of actions happen in rural China every day; official government statistics suggest that environmental protests number in the thousands every year, and such public mobilization undoubtedly exert pressure on environmental regulators and policy (Ibid.).

A meticulous mapping (rather than reckless bashing) of ongoing transitions and transformations in China is likely to reveal an increasing number of sites and sights that are suggestive of both "the subtle burgeoning of environmental civil society in China today" (Ibid.) and the fact that "no matter how solid a grip the central government appears to have on citizens and on local officials, its control is never hegemonic; those at the margins possess creative strategies for affecting the political system" (Ibid. 157).

## 8.10 Concluding Reflections

Steadily unfolding micro-geopolitics of non-violent, peaceful resistance in China and India, demanding more *grounded* environmental sustainability, promises to create more *even* spaces for social innovation that would serve common public good. In many respects, as shown by this chapter, these social-cultural struggles symbolize social innovations that bode well for the search for alternatives to highly unsustainable growth patterns causing environmental unsustainability. These struggles, despite diverse locations and agendas, share and express a common concern over the risk of *future* concerns of climate change eclipsing the *present* predicament of millions of poor and the marginalized facing the brunt of widespread degradation of land, air, and water. As rightly pointed out by the 2014 World Bank Study on *Building Resilience for Sustainable Development*, cited at some length in this chapter, the focus on the future risks must not be at the cost of losing sight of both historic responsibilities and current practices.

The official framings of climate change issues in both China and India continue to oscillate between the 'scientific' imperatives of deterritorialized-global understandings of climate change and reterritorialization of climate space at national scale through geopolitical and geoeconomic reasonings. The tone and tenor of climate change discourses in both the countries is tempered in some ways by the 'growth imperative', reinforced by the 'revolution of rising socio-economic expectations' demanding a better 'way of life'. The emerging political consensus seems to be that the most effective and efficient way to protect the global climate system is to assign property rights for greenhouse emissions and to trade these rights on international markets. This chapter has also shown that, in both China and India, the official responses to climate change mitigation are overwhelmingly land-centric and there is a relative neglect of coastal marine environments, especially mangrove forests, and the problems faced by the coastal communities. The 21st Conference of the Parties (CoP 21) to the UNFCCC, held in Paris in December 2015, has opened new spaces for China and India to cooperate and collaborate during the course of meeting their obligations under their respective 'Intended Nationally Determined Contributions' (INDCs).

Yet another key finding of this chapter is that the 'clash of scales' in the ongoing debate on environmental sustainability and climate change demands and deserves attention from a critical social science perspective. Despite the truism that most human-environmental interactions take place at the micro-local scale, the national and the global scales continue to be both hegemonic and homogenizing. The climate change metanarrative (McCarthy 2013) also tends to conceal the longstanding histories and geographies of environmental unsustainability and environmental injustice in various parts of the world, especially Global South, and thereby push under the carpet various innovative social struggles that have emerged out of the resolve of local communities to *embrace* and *interact* with their changing environments in terms of not only their needs, but also values.

Mahatma Gandhi once talked about majestic oceanic circles, i.e. about the independence of the grassroots. According to Gandhi, centralized government is inherently prone to violence. By contrast, he advocated the decentralization of political power. The same could apply to the governing arrangements at the regional and global scales. Explaining his metaphorical vision of the structure of a future non-violent society, Gandhi wrote: "Life will not be a pyramid with the apex sustained by the bottom. But it will be an oceanic circle whose centre will be the individual always ready to perish for the village, the latter ready to perish for the circle of villages, till at last the whole becomes one life composed of individuals, never aggressive in their arrogance, but ever humble, sharing the majesty of the oceanic circle of which they are integral units" (cited in Murthy 1987: 189).

What is important here for the purposes of concluding this chapter is the contrast between the inclusive spatiality and the horizontal spacing of the 'oceanic circles' of Gandhi's geographical imagination of political economy of life and the exclusive spatiality and the vertical spacing of the various competing, often colliding, conceptualizations of state-centric space and scale. *An unorthodox imagination of replacing 'scales' with 'circles' might open up new intellectual spaces in pursuit of social innovation howsoever defined.* The metanarratives of climate change, framed largely in terms of global scale and global governance, will no doubt continue to privilege govern-mentality with regard to both mitigation and adaptation on the one hand and co-opt or subvert the concerns and perspectives of local communities situated on the geographical-political peripheries. It is rather ironical that those who remain on the margins for all practical purposes (be it the coastal communities of ISD or ZMNR) are *central* to the dominant framings of victims of climate change by various agencies and actors including IPCC, think tanks, and 'civil society'.

This chapter has shown that innovations for sustainable environments, on land and at sea, are unlikely to be realized in the absence of a rigorous pursuit of social innovation through an equally innovative and contentious grass root politics anchored in participatory democracy and environmental-social justice. This demands decentralized political systems marked by non-domination as the fundamental principle of governance at all levels. Looking at Chipko in retrospect (and also in terms of prospects) has been extremely useful for the purposes of this chapter. Chipko has been creatively imagined as a 'migratory bird', which is a very useful way of looking at social innovation. The Chipko also reminds us that both physical and human geographies play a central role in various pursuits of environmental sustainability.

The ancient civilizations of China and India have longstanding geographies as well as histories of resistance. 'Decolonization of mind' remains critically important in search for alternative imaginations of space, scale, and power. The micro-geopolitics of resistance is unlikely to acquire entirely similar forms, trajectories, or even outcomes in China and India but the carriers of this multifaceted non-violent resistance from below—i.e. micro-movements against unsustainable environments—should be brought into a face to face relationship through a trans-local dialogic conversation among apparently scattered and fragmented monologues. There are valuable lessons to be learnt from each other's experiments and experiences in

social innovation in strategizing resistance from below through foot marches, petitions, and even silent candle light processions. The spirit and philosophy of Chipko will acquire its own Chinese characteristics and lingua franca both on land and at sea. Hopefully sooner than later, innovative transnational social-environmental-climate justice solidarities, "forged out of collective articulations of different place-based struggles, and constituted as the varied interconnections, relations, and practices between participants" (Routledge 2011: 386), too will develop between the two 'civilizational twins'. Social struggles in China and India remain central both to social justice and people-centric innovations aiming at socially just environmental sustainability.

**Acknowledgments** I gratefully recall and acknowledge here the powerful intervention made by Dr. Lily Ling of The New School, New York, on 'decolonization of mind' during Q & A of session 3 of the ICI Conference, Environment in India and China, held on 1 December 1, 2012. Her critical scholarship and relentless search for 'multiple worlds' in international relations is a major source of inspiration for this study.

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# Chapter 9
# Designing Mega Delta Interactions

**Victoria Marshall**

**Abstract** Indian and Chinese urbanization is rich with possibility for global urban design theory and practice because the village city systems in India and China offer a reevaluation of what we consider a city to be and how design is to be engaged within it. The mix of urban and rural has very different definitions in India and China, which again are different than those in the United States and Europe. This chapter, which is paired with a drawing set, is a study of this urban form in order to support better India–China interactions and to question the reproduction of unsustainable heterogeneous mixes globally. In the context of the rapid urban transition of today it is important to imagine ways that an inclusive, but not totalizing, regional outlook can support action against environmental unsustainability. This chapter is a contribution toward this goal.

**Keywords** Ganges-Brahmaputra-Meghna Mega Delta • Bhagrathi-Hooghly River • Delta interactions • Ecological Urban Design • Metamosaic approach • Yangtze-Qiantang Mega Delta • Patch dynamics

## 9.1 Introduction

This chapter is a design project and a situated study of urban forms in transition. It is located in wet landscape village city systems in Asia, and these are visualized in the same way that urban ecologists approach urban ecosystems. Seeing ecologically is a spatiality that takes into account urban heterogeneity, which is the messy mix of urban elements that make up our city systems, and environmental subject formation, which is the way people understand themselves and their agency within this shifting mix over time. In addition, the visual ecologies presented in this chapter are designed politically. What this means is there is a participatory focus and the

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S. Dong et al. (eds.), *Environmental Sustainability from the Himalayas to the Oceans*, DOI 10.1007/978-3-319-44037-8_9

drawing methods engage visual tools that are familiar, qualitative, and easily assembled in a chaotic urbanizing context.

Geographer T. G. McGee argued in 1971 that there is a unique blend of urban and rural in the village city systems specific to Asia he named *desakota*, based on Jakarta in Indonesia (McGee 1971). Desakota was an attempt to explain the growth of non-agricultural activities in the space between urban and rural regions of many of Asia's largest cities. Today, it is considered a part of a larger discussion on urban transitions, and it is used as an example of why a linear and inevitable transition model is flawed as a model to investigate urbanism (McGee 2009). As described by McGee, traditional urban transition characteristics were the modernization transition from traditional to modern societies, the demographic transition from low growth to high growth to low growth societies, the urban transition from low to highly urbanized societies, the environmental transition, and the transportation and information transition. McGee's observation was that the pace is occurring at a much faster rate than that of earlier transitions, and transitions are now overlapping or "telescoping" (Marcotullio and Lee 2003). In addition, and most importantly for today, the urban transition is being driven in new ways. In his words, "interaction and linkage is a more accurate reflection of reality than the idea that rural and urban are undergoing somehow spatially separated transitions" (McGee 2009: 6). This chapter takes account of the nonlinear spatial effects of these interactions and linkages in order to create means for imagining more equitable futures in mega deltas.

Ecologists Steward Pickett and Mary Cadenasso and urban designers Brian McGrath and Grahame Shane have focused on city modeling in similarly nonlinear and nuanced ways. They engage a nested mosaic framework that they entitle a metacity approach for modeling urbanization and shaping change (Pickett et al. 2013; also see Shane 2011, 2016; McGrath and Pickett 2011, 2016; McGrath and Shane 2012). Pickett, Cadenasso, and McGrath describe three types of urban mosaics: process mosaic, choice mosaic, and outcome mosaic; together these constitute the urban metamosaic. They state that "The metacity is a scale-independent concept that can be placed in a nested hierarchy of mosaics like a moving window of observation," and continue "These mosaics, like the metapopulations and metacommunities of ecological science, are thus systems of systems" (Pickett et al. 2013: 477). To date the metamosaic conceptual tools have been explored using a patch dynamic approach for the Gwynns Falls Watershed in Baltimore, USA (Grove et al. 2015). This chapter elaborates the patch dynamic approach in urbanizing wet landscape contexts in Asia, with an experimental participatory lens, and a focus on drawing as a practice for understanding and shaping subjective environmental knowledge and design.

The research presented in this chapter is directed toward an assumption that better situated ecological understanding must be created for politics—to support emerging open society and global civil society (see Chaturvedi, Chap. 8 in this book) and the new Asian city. McGee explains that "the inner city, urban periphery, and urban rural mix are seeing a trend toward increased land conversion practices and auto-centered transportation systems all ordered by shifting networks of linkages, as described above. Each is a zone of contact between macro processes and

micro processes, a place of decisional congestion, environmental conflict, landuse conflict, and social tension" (McGee et al. 2007: 214). Patches are, therefore, sorted in this chapter to illustrate changes in urban form and public space encountered during extensive and repeated fieldwork by the author from 2010 to 2013. In this case, fieldwork is not only a practice of ground-truthing satellite imagery. It is also a practice of querying a patch mosaic in order to redraw it and reveal meaningful emerging patterns. Although peri-urbanization in Asian deltas functions within scales other than the hyper-local, it is the repetition of elements, effects, and exchanges that form patterns of complex mosaics and when compounded have ecological effects of regional reach. These changes are not smooth; they are actually patchy and this phenomenon is poorly researched.

In addition to the metacity, urban designers Brian McGrath and Grahame Shane theorized two other city models as meaningful terms for urban theory and design practice, particularly architecture: the metropolis and the twinned megalopolis and megacity (McGrath and Shane 2012). They note that a proliferation of definitions and meanings of the terms city, metropolis, and territory has emerged in the last 30 years. They explain that there has been competition between normative models each with its own formal order, metabolism, and role for architects in the shaping, imagining, representing, and modeling of the city. Rather than claiming that one city is a megacity and another is a megalopolis, they state that all models "currently coexist and interact in the contemporary urban landscape but rarely in the designer's imagination, as they become distinct territories of both theory and practice" (McGrath and Shane 2012: 642). Therefore, they offer these co-present city models in an urgent conciliatory manner, as a shared organizing system for critical reflection and collaboration between architects and urban designers, while acknowledging the limits of such a task.

Geographer Jennifer Robinson in her survey of the comparative gesture in urban theorizing imagines a mode of learning where a more interconnected field of research could draw both inspiration and method from the cities that form its objects of study (Robinson 2011). She explains further.

> "Their interconnectedness might inform our eagerness to proliferate conversations across scholarships embedded in different urban contexts at the same time as it directs us to new units of comparison. Their diversity and multiplicity might inspire us to be quick to unsettle parochially derived theoretical certainties through engagement with different cities even as we embrace more nuanced forms of explanation and method appropriate to the complexity of cities. An urban theory on a world scale could, then, potentially draw more cities into shared fields of analysis, and be characterized by multiple, frequently unsettled and hopefully unsettling conversations about the nature and the futures of cities in the world. This style of theorizing would be neither a parochial universalism nor a uniform global analytical field but a rich and fragmented array of ongoing conversations across the world of cities" (Robinson 2011: 19)

Comparison is engaged in this chapter as paired research in order to test a framework and its applicability beyond the American Northeast. Cities in this chapter are not viewed as complex wholes, but rather, learning from McGrath and Shane, atten-

tion is given to the special mix of city models that have informed their development over time. Unlike McGrath and Shane, this chapter engages paired research beyond conciliation. Learning from Robinson, paired research is engaged in such a way to disambiguate situated unsustainable heterogeneous mixes in order to open a dialog between people in two mega deltas and to further open up critical urban theory and practice.

Mega Delta is a generic term given to the very large Asian river deltas: the Yellow (Huang He), Yangtze (Chang Jiang), Pearl, Red, Mekong, Chao Phraya, Irrawaddy, Ganges-Brahmaputra, and Indus. The Asia-Pacific Network for Global Change developed this term in 2004 as a shared concept toward establishing capacity building networks amongst fluvial and coastal specialists of the Asia Pacific regions (Chen 2004). Inspired by this convivial capacity building goal as well as an understanding that the largest Asian cities continue to grow fastest, particularly coastal cities, many of which are located in these fertile river deltas (UN 2011), this research, therefore, aims to increase awareness of Indian and Chinese peri-urban systems. The case study areas are east Kolkata in the Ganges-Brahmaputra-Meghna Mega Delta and east Shaoxing in the Yangtze-Qiantang Mega Delta. In addition to earth scientists, all mega delta residents are included here as fluvial and coastal specialists.

This chapter comprises four sections that are introduction, visual ecology, paired research, and conclusion. Visual ecology explains the methods used to address the research question: how might cocreated models of patch dynamics address environmental unsustainability in peri-urban wet landscape environments in India and China? First, metamosaic theory is described as an innovation in the context of the field of ecology. Then, patch dynamics is explained through the making of a paired inter-referenced drawing set. There is an emphasis on describing ecological concepts, drawing tools, and the design decisions made in constructing the drawings. This is so that readers, who may not consider themselves visually inclined, may understand the compositions more fully. Paired research is the case study section and is, therefore, the illustration and narration part of the design project. It includes an India case study and a China case study as well as a reflection that further clarifies how the inter-referenced drawing set is a project for the public realm. The chapter concludes by resituating peri-urban patch dynamics within mega delta village city systems, the subject of what constitutes a city, and how design is to be engaged within it.

## 9.2 Visual Ecology

In 1985, ecologists Steward Pickett and Peter White noted that “ecologists have always been aware of the importance of natural dynamics in ecosystems, but historically, the focus has been on successional development of equilibrium communities” (Pickett and White 1985: pxiii). They continue, “While this approach has generated appreciable understanding of the composition and functioning of

ecosystems, recently many … have turned their attention to processes of disturbance themselves and to the evolutionary significance of such events." This shift in interest has since inspired studies of diverse systems, including cities, a relatively new site for ecology research. Pickett and White use the term patch dynamics to describe the common focus of the disturbance-related phenomena, to stimulate the generation of explicit hypothesis and theory, and to identify areas of future research. This shift in interest is also explained as a shift from equilibrium ecology to disturbance ecology and it was an important development in the history of ecological thought.

Today, patch dynamics is explored as a shared conceptual tool between urban ecologists and urban designers at the Baltimore Ecosystem Study (Cadenasso et al. 2013; Cadenasso 2013; McGrath et al. 2007). The BES is a long-term ecological research project funded by the United States National Science Foundation, and the author is a member of this research team (BES 2015). A patch may be considered a shape that is fixed; however, the concept of a patch in this case is relational. It describes a set of patches or a mosaic that changes over time. "Patch implies a relatively discrete spatial pattern, but it does not establish any constraint on patch size, internal homogeneity, or discreteness; patch implies a relationship of one patch to another in space and to the surrounding, unaffected or less affected matrix; patch dynamics emphasizes patch change" (Pickett and White 1985: 4). Patch dynamics was created because existing ecological frameworks were inadequate for understanding the heterogeneity of urban systems.

The disturbance ecology approach changed many shared scientific understandings between ecologists. In 2007, Pickett and Cadenasso summarized the new set of background assumptions (Pickett and Cadenasso 2007). These are: ecological systems can be open to material exchange with other systems; factors from outside a specified system can regulate system behavior; there may not be a single stable equilibrium point for system composition or behavior; disturbance can be part of the dynamics of a system; succession or response to disturbance can be highly unpredictable or probabilistic; and humans, including their institutions and behaviors, can be parts of ecological systems. They then posed a question: how can urban designs be models of patch dynamics? In this chapter the relation between design and ecological models is arranged differently. Here, the question is framed as follows: how might models of patch dynamics be critically co-created by residents, urban designers, and ecologists?

Rather than a linear urban to rural transect, village city systems intensify and age in patchy and complex spatial patterns with urban forms and ecosystem processes, degrading, densifying, or diversifying in similarly fragmented ways. This chapter features a set of digital drawings that illustrate this fragmentation as patch dynamics. The drawings are made by hand and are sorted to reveal heterogeneous mixes of land cover and that change over time in both shape and content. They are made of layers and are subjectively edited to reflect observations made during extensive fieldwork in the urban periphery of east Kolkata, India and east Shaoxing, China—areas that were selected for their heterogeneity, visible evidence of urban change in the past 10 years, and the availability of quality aerial imagery (Marshall 2013).

The six drawings titled *Patch* that are featured in the case study section are a time series. Aerial imagery from Kolkata and Shaoxing created in 2002, 2007, and 2011 are arranged side by side. Patch boundaries were drawn on each aerial image so that patch change might be studied. In order to see change, white space is used as a visual element. Any patch boundary color might be used; however, white is useful in this case as it creates a strong contrast with the blue, green, brown, and black that dominates aerial imagery in these mega deltas. When certain types of patches are turned off, they become masked by the white space and emerge as figures and form the subject of the image. When each edited aerial image is viewed in relation to the next a dynamic pattern is revealed. For example, patches disappear, new ones emerge, some change shape, and some change content.

Two patterns are explored in the paired research case study section and are introduced here as fine grain and coarse grain patterns. Fine grain is a term that references small buildings or small areas of vegetation such as yards, and coarse grain is a term that references big buildings or big areas of vegetation such as fields. Both patterns also include patches dominated by water bodies such as ponds, canals, and important roads. The fine grain and coarse grain patterns are arranged in ascending and then descending temporal order. In other words, the images are sorted as follows: fine grain 2002, 2005, 2011, and then coarse grain 2011, 2005, 2002. Selecting, tracing, sorting and arranging patches like this is a nuanced method for viewing regionally. In this case grain has been chosen because it is an earthy term that can be understood historically in these rice-growing regions, as well as formally, because different granularity of urban forms shape environmental effects and social relations. In addition, the ascending and descending register is also intended to productively unsettle familiar categories. Like the tide or monsoon, and unlike a linear rural to urban transition or a growth obsession, the ascending and descending register is a nonlinear spatiality.

Drawing is a way of thinking visually. The experience and practice of drawing is an act of finding a balance between visual and conceptual intrigue surrounding a particular question, issue, or observation. It is "halfway between intellectual understanding and sensual experience" (Garner 2008). It does matter what tool is being used, as this informs the designers body sensations and imagination; however, this is not the defining factor. For example, a tool might be a pencil and a paper sketchpad. The drawings titled *Scroll* that are also featured in the case study section were created with the following tools: camera, GPS device, mouse, computer, software, web sites, and an Internet connection. Similar to the patch drawings described above, the scroll drawings were made with layers and employ, color, line, scale, pattern, balance, indexing, and depth. Design decisions were made at various stages in creating and assembling the drawing parts, and these are explained below however, it is important to explain more about ecosystem boundaries first.

Ecosystem scientists practice by asking research questions about a place. In order to do this, they often use ecosystem boundaries to define the scope of their research (Cadenasso et al. 2003). In other words, an ecosystem boundary is created at the same time as a research question is formed. In this sense, ecosystem boundaries are

question specific and not preexisting conditions. For example, a boundary could be small or big, depending on the question. This type of positionality, where a boundary is formed by a question, is different than other types of boundaries such as property boundaries, or neighborhood and social boundaries. In the scroll drawings, ecological positionality is emphasized. Every photomontage in a scroll drawing is a scene, which informs the boundary that surrounds it. Scene in this sense is a moment in place. Increasingly, ecosystem scientists are asking research questions *with*, not *of* communities (Chapin et al. 2011). Therefore, these drawings aim to provide a visual explanation of how ecological research practice might be introduced and communicated to other scientists, residents, designers, artists, organizers, officials, etc. The patch and scroll drawings visualize non-equilibrium ecological spatiality within a socially engaged urban design drawing system.

Along the top of each scroll drawing are three patches, along the bottom are three scenes that are each bound by a square frame. The design process of selecting what frame matches what scene is a decision based on information because the frame is also an image that has a meaning; it represents an ecosystem boundary. The patches at the top are the location there the scene below was encountered during fieldwork. The scroll drawings are therefore, also maps and they bring forth questions: What scene would you create? What frame would you select? Who would you share this with? Why? What sort of discussion, negotiation, and actions might emerge? How might environmental unsustainability be engaged here? The scenes are arranged in six sets of three images and roughly correlate with the patch drawings as follows: scenes from fine grain patterns are highlighted first, and then scenes from coarse grain patterns, in India and then in China. Each is given a title that is a shared quality or a location, such as ‘persistence’ or the ‘big pond’, for example. A compositional decision was made to align the three scenes across the image, rather than aligning the boundaries—this is called visual hierarchy. What this means, in this case, is there is an emphasis in seeing the scenes as a scroll, rather than a set of ecosystems adjacent to each other all lined up in a neat row. The horizontal movement between the scenes is privileged, inviting a type of visual back and forth journey for the viewer within the periphery of Kolkata and then Suzhou.

## 9.3 Paired Research

This section presents a paired research application of the metamosaic approach. The Ganga Brahmaputra-Meghna Mega Delta and Yangtze-Qiantang Mega Delta are situated historically, and peri-urban Kolkata and Suzhou are explained and visualized in detail. Six patch dynamics drawings (Figs. 9.1, 9.2, 9.3, 9.4, 9.5, and 9.6), six scroll drawings, and two metamosaic drawings are illustrated and explained with detailed captions. In particular, the train networks in each region are emphasized because they are an immediate and familiar reference.

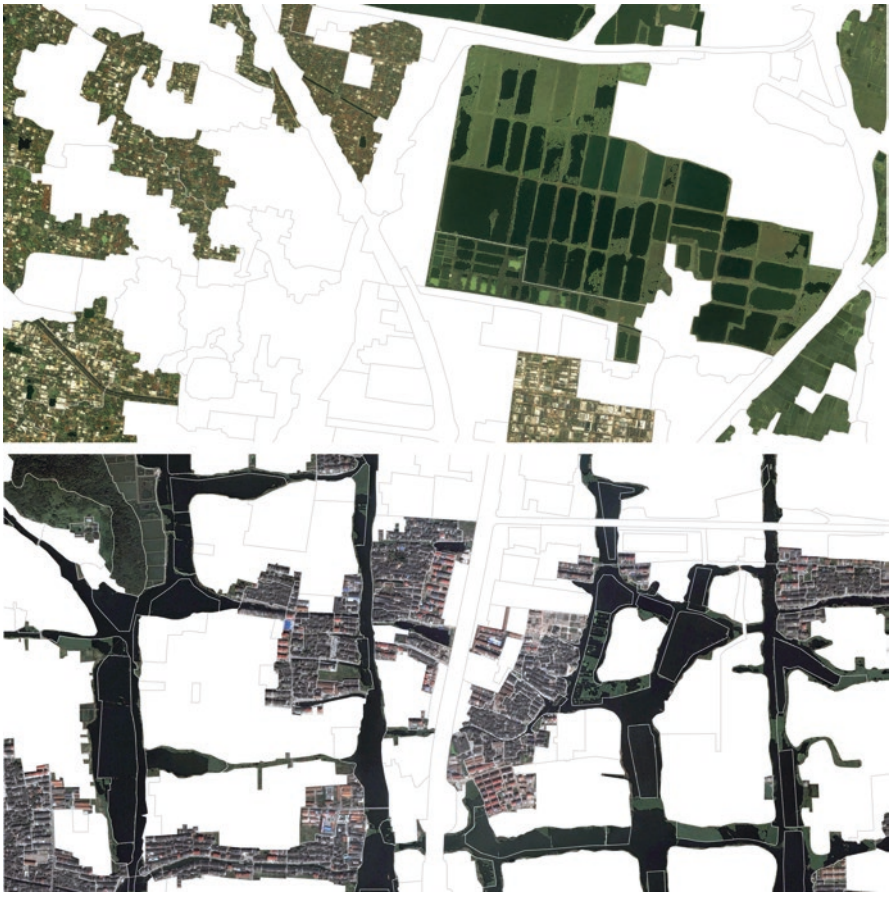

**Fig. 9.1** Patch Dynamics 2002. *Top*: India fine grain: This is the first in a sequence of three images that illustrate an increase in density and number of housing and mixed-use patches in relation to a nearby very large pond system that is decreasing in size; *Bottom*: China fine grain: This is the first in a sequence of three images that illustrate a decrease in village patches in relation to the removal of fish farms in a canal waterway network

The train network of West Bengal has a form that radiates unevenly from Kolkata, and therefore serves as a useful introduction to the Ganga-Brahmaputra-Meghna Mega Delta. On both sides of the Bhagrathi-Hooghly River train tracks run close to the shore, reflecting its long history as a port for trade such as Falta, Calcutta (Sutanuti, Kalikata, Gobindapur), Serampore, Chandennagar, Chinsurah, Hooghly, and Cossimbazar (Schwartzberg 1992). To the east the absence of train tracks reveals the wetness of the many lobes of the mega delta, and therefore it is a long northerly journey that connects Kolkata to Dhaka—the two city centers of the mega delta. In addition, there are no easterly train lines beyond Canning and Hasnabad, and today the international border with Bangladesh positions these towns as two of

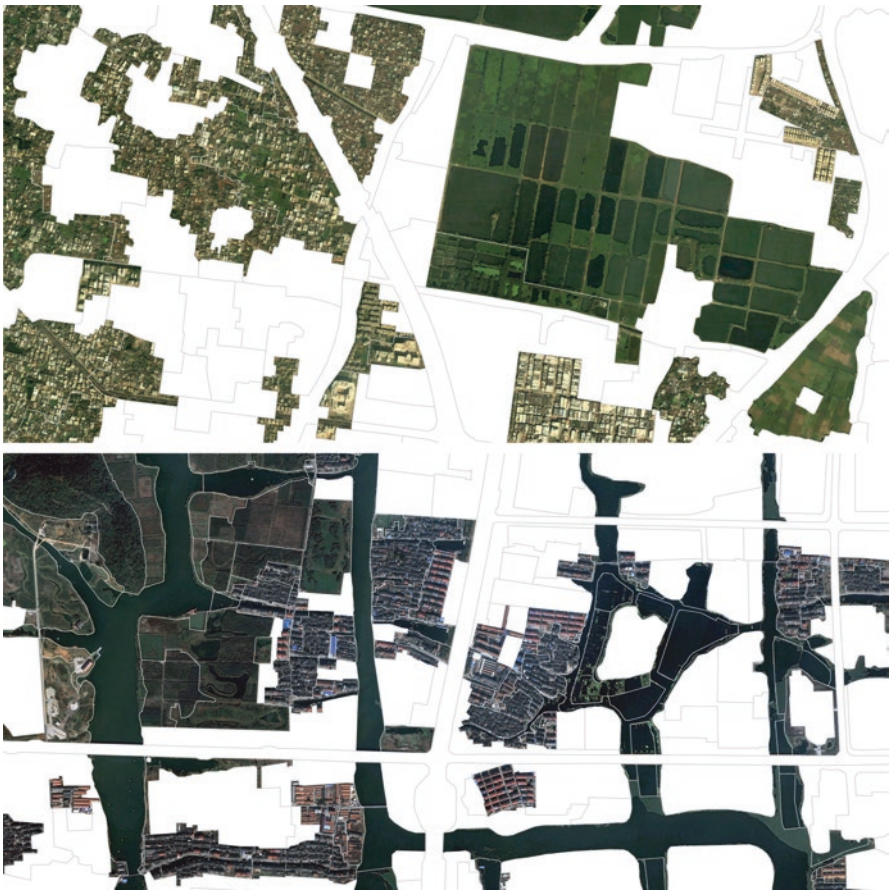

**Fig. 9.2** Patch Dynamics 2007. *Top*: India fine grain: In this image, you will see a large ponded area to the right that is also an eco-park. It is adjacent to and outside of the East Kolkata Wetland boundary, which is further toward the east. On the *top right* is a resettlement colony; *Bottom*: China fine grain: In this image, you will see that some canal waterways are now wider and have less fish farms than in 2002. This is because this part of the canal waterway is being transformed into an inland water highway

many in a long north-south porous borderland (yellow line) (Fig. 9.7). In the urban periphery train tracks, roads, and canals in the flat delta are also dikes that are support and delivery corridors, as well as water storage and distribution systems.

To the west and south, and in general, trains orient life in the countryside with urban commuters who return to their rural towns and villages at night. This phenomenon, which is a type of urbanization on the move is also called circulatory urbanism (Srivastava and Echanove 2015). A pressured congestion is tangible in the train carriages that arrive and leave each day with their workforces, as well as in the intense street life in Kolkata. In the inner city, the train tracks form long borders adjacent to dense neighborhoods that become even more congested and multilayered

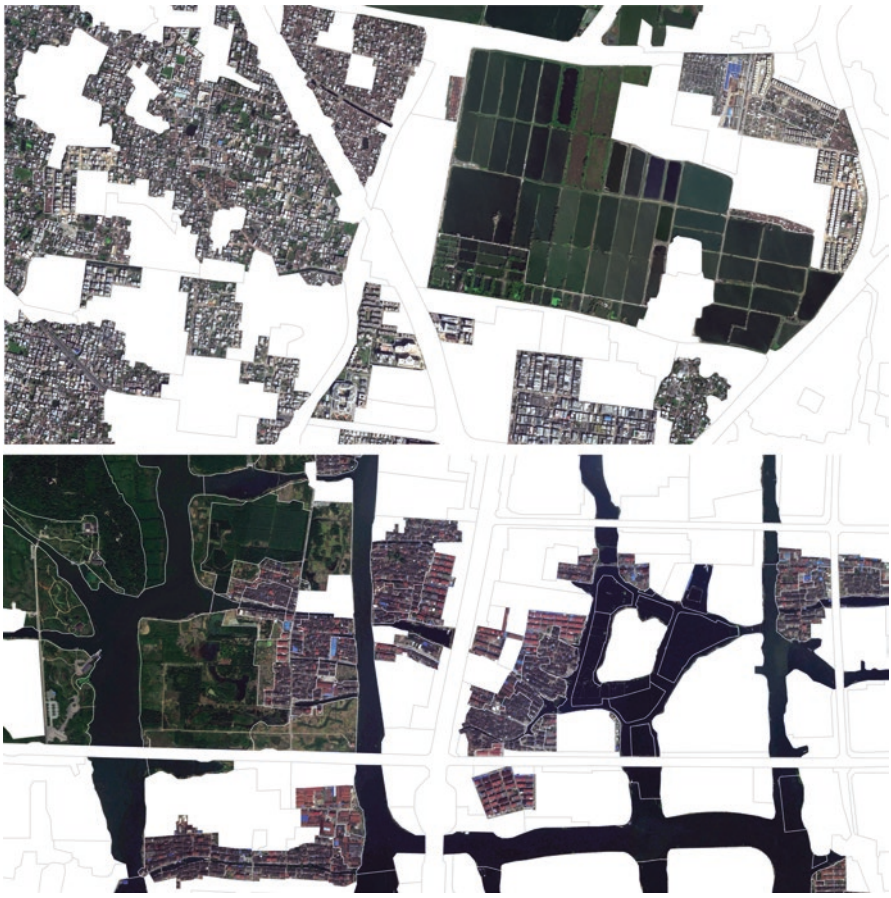

**Fig 9.3** Patch Dynamics 2011. *Top*: India fine grain: In this image, you will see that the fine grain housing and mixed-use patches are denser, bigger, and there are more of them; *Bottom*: China fine grain: In this image, you will see that many patches that include villages have been removed. In the *top left* corner, you will see a new eco-park with demonstration wetlands and boardwalks, hiking trails to a viewing pagoda, and reforested paddies

at rail crossings. In the eastern edge of Kolkata, east of the two train lines that branch out from Sealdah Railway Station (toward Barasat to the north and Sonarpur to the south) reveal changes that have occurred in the last two decades are described below as sequential and invisibly sectional.

A newly built wide and straight road, the Eastern Metropolitan Bypass, has fostered the conditions that make it economically viable for landowners to transform ponded, waterlogged, and wetland into dry land. This pattern of transformation is adjacent to and increasingly inside the 125 $km^2$ territory designated as the East Kolkata Wetlands - a RAMSAR site. This region was formerly tidal and it was therefore, a salt-tolerant ecosystem and it is imagined in this research project as a

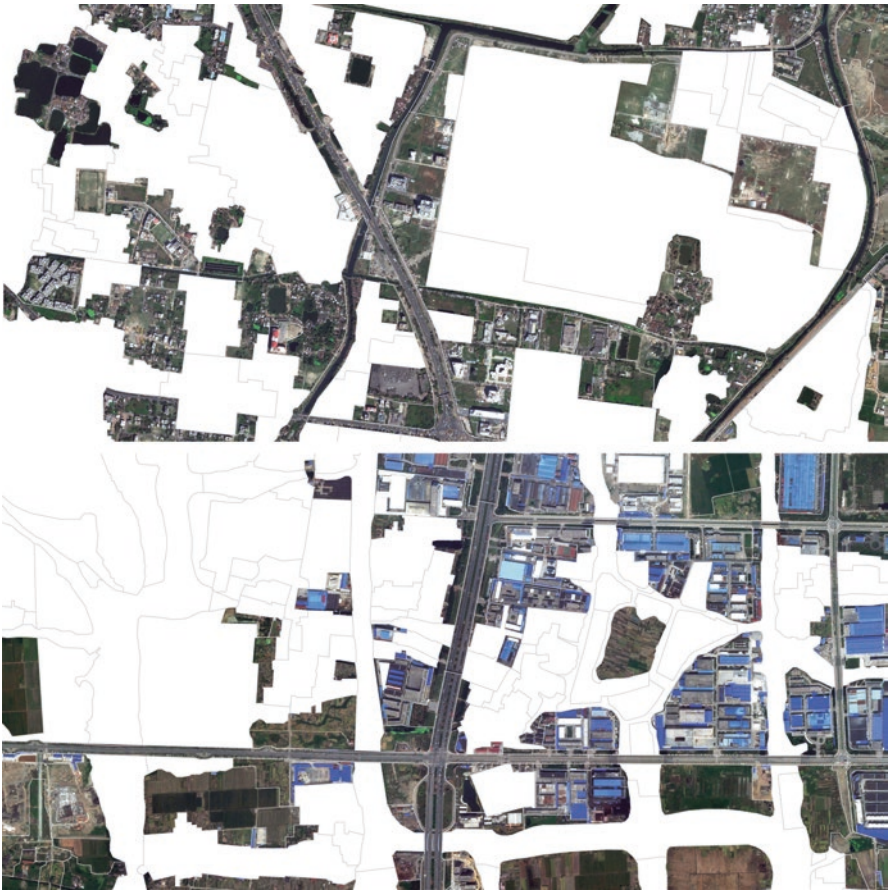

**Fig. 9.4** Patch Dynamics 2011. *Top*: India coarse grain: This is the first in a sequence of three images that illustrate the emergence of large land parcel development along the main road in relation to small ponds and long wastewater canals; *Bottom*: China coarse grain: This is the first in a sequence of three images that illustrate the emergence of many new factories that have blue roofs in relation to the construction of a new road network that is laid out as megablocks. According to a recent strategic master plan, this new factory area is soon to be replaced with a residential zone of the nearby new town to the west

type of ocean shore. A new town, information technology zone, new hospitals, five star hotels, fancy schools, shopping malls, big box retail, gated high-rise housing clusters, resettlement districts, government offices, and business headquarters now line the road and are reshaping this former shoreline. Across this mix of coarse grain patches are newer projects such as a flyover, light rail, subway extension, street widening, sewage canal upgrading, and an eco-park. In between are fine grain patches and these are where people who live in old villages, old and new housing colonies, and old and new bustees sleep and work. They renovate their homes floor-by-floor, wall-by-wall, room-by-room, and well-by-well as they become more pros-

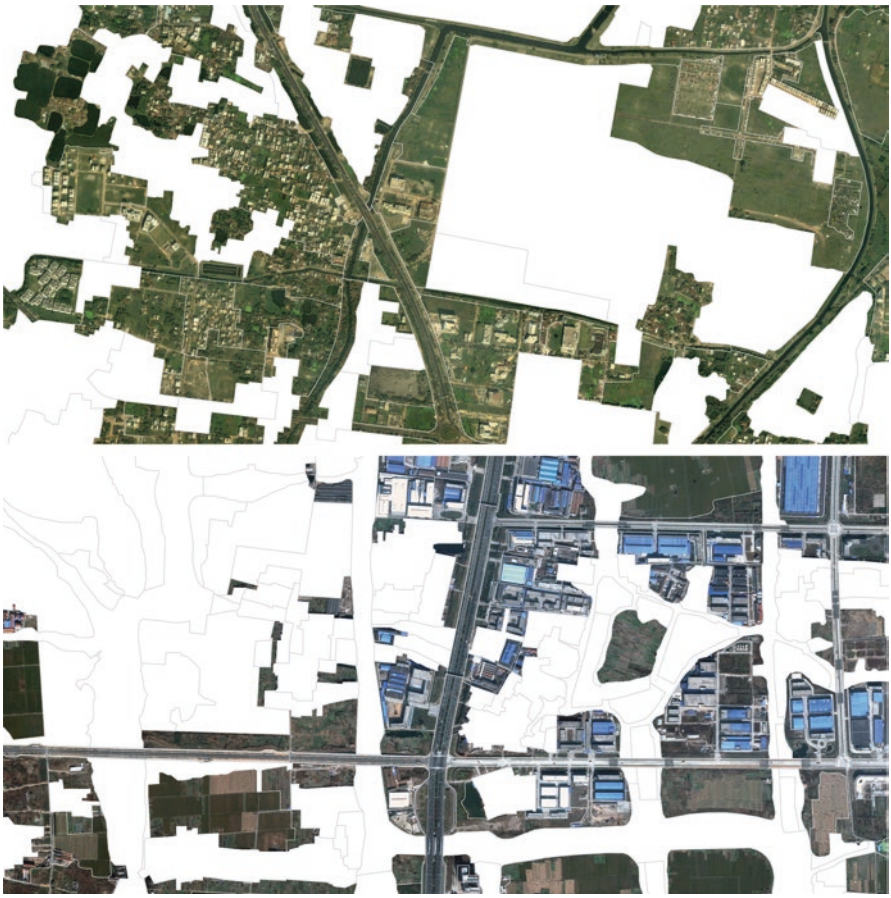

**Fig. 9.5** Patch Dynamics 2007. *Top*: India coarse grain: In this image, you will see the wastewater canals that have recently been renovated using funds from the World Bank. The north south main road is the Eastern Metropolitan Bypass (EM Bypass). *Bottom*: China coarse grain: In this image if you look closely, you will see many small peri-farming gardens. Look for areas that have a more mixed green texture than say a monoculture field of crops, weeds, or bare soil

perous, or to make ends meet. The site-by-site, fragment-by-fragment micro changes in these fine grain patches are relational to the coarse changes brought by the Eastern Metropolitan Bypass. Once a short cut to the airport, the eastern edge of Kolkata is now a work, entertainment, recreation, and shopping destination with major traffic, and encroachment issues. Both roadsides are lined with commuters waiting for trucks, buses, taxis, vans, carts, and auto-rickshaws. A view from the road reveals displays of giant billboards selling jewelry, holidays, and apartments. Also for sale are marble products, decorative pots, house plants, and cars. The shoreline is either dusty or muddy and it is always noisy because Kolkata drivers use the horn to communicate all sorts of polite and assertive vehicle maneuvers.

**Fig. 9.6** Patch Dynamics 2002. *Top*: India coarse grain: In this image you will see the large areas of open land, dispersed housing colonies, and villages with ponds and lush vegetation. You will notice that the EM Bypass is narrower. Today it is being widened again for an elevated highway and metro. *Bottom*: China coarse grain: In this image you will see the many rice paddies that were under cultivation in 2002 as well as the first factories that are aligned toward the new road, rather than the waterway canals

The Ganga-Brahmaputra-Meghana Mega Delta was settled by clearing the formidable tiger inhabited jungle for farming and trade settlements. Access was via rivers, braided tidal creeks, and much later via the Grand Trunk Road. According to Bengal historian Eaton, around 1666 the Ganges channel to the Portuguese trading station of Satgaon was finally no longer navigable (Eaton 1993). The siltation process was the result of an avulsion, one of many in an ongoing hydrogeological process of the eastward stepping of the lower delta plain of the Ganga-Brahmaputra-Meghana Mega Delta (Allison et al. 2003). Rivers switch channels toward the east here because of the ongoing collision of the Burmese plate overriding the eastern margin of the Indian continent and its adjacent oceanic

**Fig. 9.7** Ganga-Brahmaputra-Meghna Village City Region

crust. The Bengal Basin has been subsiding since the Eocene (Kuehl et al. 2005: 414). In everyday terms, the avulsion was explained to the author with some melancholy, like a friend who has gone away and won't be coming back. "The Ganga has gone to Bangladesh." Today, the Farakka Barrage replenishes the water flow in the Bhagrathi-Hooghly River—which continues to be respected as the Ganga. The barrage was built in 1975, and it is a type of dam that also diverts water along many feeder canals.

There are two key physical environments to the Ganga-Brahmaputra-Meghana Mega Delta, the upper delta plain and flood basins (3 m>15 m) which extends 200 km landward of the second part, the salinity influenced lower delta plain and delta front (<3 m) (Kuehl et al. 2005: 417). Kolkata is just north of the transition between the upper and lower delta plain. Common features of the upper delta plain are meander scars, abandoned channels, oxbow lakes, as well as levees and back swamps in between inter-distributary levees. Common features of the lower tidal plain are tidal creeks, tidal mudflats, distributary levees, and inter-distributary marsh complexes (Bhowmick et al. 2012). Siltation continues to pose a navigation challenge in the Bhagrathi-Hooghly River. A new port at Sagar Island is under

review by the Kolkata Port Trust and the Government of West Bengal. At 100 km south of Kolkata, the new port is much closer to the Bay of Bengal and is adjacent to the Sundarbans National Park. Port funding comes from public–private partnerships and the reallocation of funds for dredging therefore, in future the Bhagrathi-Hooghly River will see more barge traffic. In addition, the grand metropolitan riverfront of Kolkata will transition further into a seasonal spillway and a tidal creek, seeming closer to the shifting shoals and mangrove forests of the lower delta plain.

In Kolkata, there is currently a groundwater deficit and what this means is that groundwater flows toward the inner city from the countryside, and not toward the sea (CGWB 2015). This is because more water is drawn out of the groundwater than flows in naturally. Most of the inner city has been settled above a layer of clay that protects the ground water from contaminations. On the eastern edge of Kolkata, the clay layer is thin and groundwater is hydraulically connected to surface water bodies and is polluted. The heterogeneous peri-urban changes described above are, therefore, invisibly sectional in ways that are important to understand for human health and livelihood sustainability. The drawing titled *Cloud* (Fig. 9.8) illustrates this spatial arrangement. Included are the Eastern Metropolitan Bypass, the East Kolkata Wetland, mega development blocks (yellow zones), ponds (white dots), and canals (pink lines). The groundwater sink is represented as a singular forceful circular shape (grey zone), and all of these elements are layered into an aerial image that includes an ominous monsoon cloud and the Hooghly River (wide white line).

The Beijing-Hangzhou Grand Canal and the Zhedong Canal formed an important trade, transportation, communication, and cultural connector between northern and southern China from the Sui dynasty (518—618 AD) to Qing dynasty (1644–1912 AD). In the Yangtze-Qiantang Mega Delta, it is a useful base upon which to describe how this z-shaped urban region (traditionally called *Jiangnan*) formed hydrogeologically (Fig. 9.9). According to the China historian Yoshinobu Shiba, the canal (pink line) is indicative of a boundary between the old and new delta where the landward side was settled earlier than the ocean side (Shiba 1998: 139). On the landward side of the Beijing-Hangzhou Grand Canal were settlement patterns of hills and fan/slope complexes. On the ocean side were the low-lying plains, sandy elevations, and lowlands. What is important to note is that the present day shoreline is a relatively recent sedimentary geology formation and the result of centuries of human–water interactions such as the construction of dikes, canals, and water gates.

Shiba explains that the earliest village settlers built reservoirs at the heads of alluvial fans and created the fan/slope complex. These reservoirs served to manage seasonal rainwater that rushed off the hills and created a permanent fresh water supply, as water tended to percolate through the loamy soil. The low-lying plains, sandy elevations, and lowlands nearer the ocean, expanded eastward into the sea up to the fourth century at a rate of about 1 km every 40 years, and from the fifth to the twelfth century a pace of 1 km every 27 years (Shiba 1998: 231–232). Environmental historian, Mark Elvin explains that the rapid filling of many deltas in China, including the Yangtze, can be attributed to eroded soil dislodged by upstream deforestation (Elvin 2004: 23). These silty shores formed swampy areas and lagoons that were

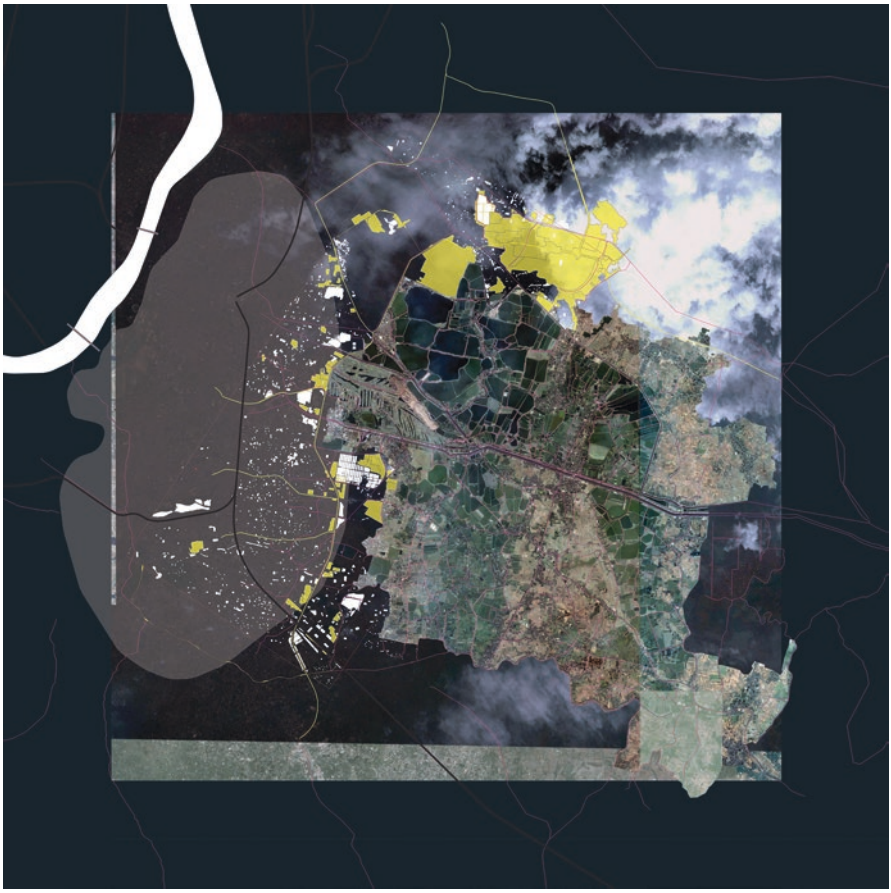

**Fig. 9.8** Cloud

protected from ocean tides and currents by river levees and sand bars, and were used for salt production and fishing.

In the eighth to thirteenth century there was a population migration and reclamation intensified the sedimentation process. Earthen sea walls were built to separate fresh from salt water, to harvest land from the sea, and enclosures were made to convert the new delta plains to paddy (Shiba 1998: 231). The "reclamation is what created much of the Jiangnan region … The site of what is now its greatest city, Shanghai, only emerged from the sea in about the thirteenth century. Jiangnan is thus, in a sense, a 'Chinese Netherlands'" (Elvin 2004: 24). Shaoxing is a smaller city located in between the larger cities of Hangzhou and Ningbo. Located on the southern shore of Hangzhou Bay, Shaoxing is where the author participated in a competition to design a coastal new town (Haar and Marshall 2012). It is also where

**Fig. 9.9** Yangtze-Qiantang Village City Region

the early settlement patterns described above were first created and then expanded elsewhere in the Yangtze-Qiantang Mega Delta (Shiba 1998: 144).

The Nanjing-Hangzhou Passenger Railway was completed in 2013. It bypasses Shanghai and travels directly between Nanjing and Hangzhou along the western edge of Lake Tai. High-speed train tracks in China are elevated where they cross water bodies—and there are many in the mega delta—therefore canals, farm roads, and fields are connected below them. In Shaoxing, there are two fast trains and one is faster than the other. The old fast train enters the northeastern edge of the city adjacent to the old slow train. It is aligned with the wall of an old reservoir that supported the fan/slope complex—described above. The newer faster train is located farther away toward the Bay of Hangzhou. The tracks curve across many former seawalls and shorelines that were once part of the ocean. This is the new delta where land continues to be annexed from the bay even today. Standing at the edge of the shoreline one can see large earth moving equipment and government contractors building new levees, rather than organized group activities of farmers or the military of earlier times.

The area in between the high speed trains and in between the old reservoir and an earlier old seawall is the peri-urban area of focus for Shaoxing in this chapter. In Kolkata, change was described as sequential and invisibly sectional; here, it is simultaneous and visible. In Shaoxing many new towns, economic and technological

development zones linked by new roads are planned, are under construction, and have been built. It seems as if the whole area is in flux all at once. The region is part of the expanding port of Shanghai, and it is also within the gigantic coastal development planning area created by Zhejiang province. Designed and arranged according to the planning protocols of the Chinese government these coarse grain changes are led by multiple 5-year concurrent and coordinated strategic land-use master plans.

Rural factories, water villages, rice wine paddies, and a network of inland canals, creeks, and lakes that once supported a prosperous market town economy with international trade are changing rapidly. When a new town is built, the megablocks are constructed first. Their giant rectilinear measures form a vast open grid within which water villages sometimes persist in the rapidly filling or filled in gaps. The village residents witness change all around them, shifting livelihoods while staying in place, relocating nearby, or migrating to a new city and adapting to new lifestyles while keeping old livelihoods. For example, residents continue everyday fine grain practices such as vegetable and clothes washing in canals, and fish farming wherever water and soil remain healthy. There is much industrial pollution in the waterways from textile and paper factories. When rice fields are closed down some people tend peri-farms. This is possible because fertile farmland soil is excavated and moved around in preparation for the basement level of new office towers, residential building clusters, industrial estates, tree lined boulevards, and eco-parks. Peri-farms are also created on roadsides, tracts of land adjacent to new relocation housing, bridges and islands not yet connected by the megablocks.

In the water, new bamboo stakes and floating nets made from plastic water bottles are used to mark out fish farms and are aligned to accommodate increased boat traffic on the Zhedong Canal. Old bamboo stakes mark out fish farms adjacent to new industrial estates that are the site of former villages. Many fish farms have been removed completely and farmers become fishermen and simply cast nets from their boats. The drawing titled *Tide* (Fig. 9.10) illustrates the spatial arrangement of the megablocks (yellow lines), water villages (small white blobs), fields, fish farms, train lines (black lines), canals (pink lines), water highway, eco-parks, industrial and residential estates. The old reservoir and some of the many former shorelines are represented as forceful shapes (white transparent zones). All of these elements are layered into a geo-located aerial image that is striated. The stripes are sort of temporal error in which differences in seasons and weather events are visible as satellite scans that are aligned.

In Kolkata, there is an urban pattern of very small urban ponds and very large lakes that are a type of commons. The small ponds are called *pukurs* in Bengali (a larger water body is called a *dighi* or *jhil*) and were typically excavated as a pious activity, and as a practice for the salvation of the soul (Ray 2010a, b: 19). The excavation of ponds was also a practice where the earth dug was used for the construction of houses and to store water. Large ponds were shaped from the East Kolkata Wetlands, the gigantic wetland system that is today an infrastructure for wastewater, food production, and livelihoods. In Shaoxing, canals and lakes formed from shallow

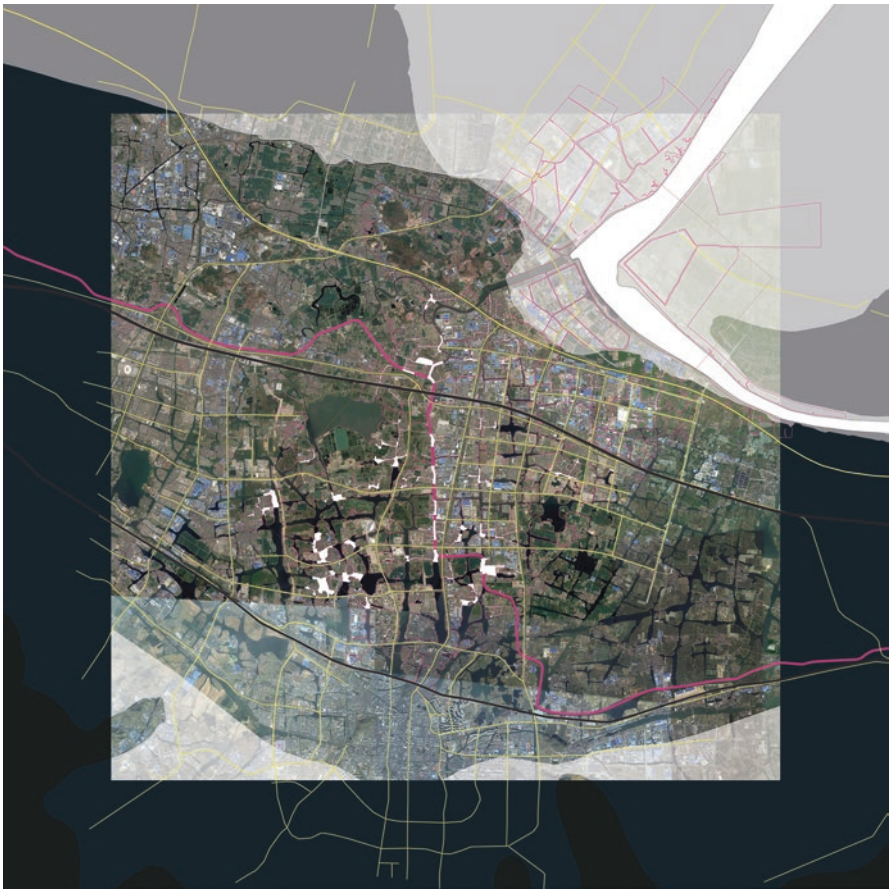

**Fig. 9.10** Tide

water held in place by sea walls. The most famous lake *Jinahu Lake* or Mirror Lake had its water source in the hills and served to regulate water supply during the dry part of the year. As lakes silted up over time, many narrow water passages remained between reclaimed islands and were used as transit corridors to connect water–villages. The patchy changes described above are splitting and sorting all of the island and canal-based villages of the Yangtze-Qiantang Mega Delta into blocks of discrete land uses, simultaneously. In Kolkata, there is extreme pressure to fill in ponds and lakes on a sequential parcel-by-parcel basis. In both regions, there are new special administrative districts such as state sponsored new towns, single developer led for-profit enclaves, public–private partnerships, smart cities systems, and inner city and periphery leisure/culture districts.

**Fig. 9.11** Recycling. This scroll connects three scenes of gestures of making and unmaking. The *left* scene is a new middle-class colony. A woman with an armful of firewood walks past a big pile of sand that is used for making concrete. There are typical low brick walls that are built to mark private land that also store water, often unintentionally. The boundary is a nearby rice paddy, and its bright green seedlings indicate the land use that the colony has replaced as well as the way that water was stored and released here. The *middle* scene is a small industrial area that is located in the *middle* of many ponds. A group of men are unloading clay from a truck. Beside them are clay teacups (*bhanr*) waiting to be fired in the nearby kiln. The boundary is a tea stall located near Park Circus, in the inner city. Chai served in these low-fired clay cups has a much-loved earthy taste. They are then smashed, discarded, and returned to mud. The *right* scene is a stack of recycled plastic, sorted according to different grades, and colors. This village has many such compounds, and the pond has since been filled in to make way for more compounds. The boundary is a roadside, just up the road and further into the wetlands, that is lined with fertilizer drying in the sun—a by-product from the leather industry

The drawings titled Scroll (Figs. 9.11, 9.12, 9.13, 9.14, 9.15, and 9.16) are the outcome of observations and experiences in this complex system of wet landscape patch dynamics and socio-morphological change. Infinite scenes are possible and eighteen are illustrated here as a prompt for further research. The drawings titled Metamosaic (Figs. 9.17 and 9.18) are a conceptual rescaling of the scrolls into a map so that they might be understood in the aerial view as spatially nested within each other as well as places along a journey.

**Fig. 9.12** Big Pond. This scroll connects three scenes around one of the largest bodies of water in the area. The *left* scene is a new street corner. A fancy new hospital is across the street from a new teashop whose customers are drivers, construction workers, and others who work in servicing this new area. They throw their trash into the pond. The boundary is a view looking up. The hospital is a landmark, and patients enjoy views across the pond. The *middle* scene is a fishermans cooperative eco-park. Two men stand by the gate and collect a small fee that pays for choice picnic spots for family gatherings. The boundary is the fence of the park that has roses, and many breezy palm trees. The *right* scene is a government-built colony that is adjacent to a Buddhist temple that has a beautiful garden, a cemetery, and a big locked gate; many of its Chinese visitors having since left the city, particularly after the 1962 war. A woman is returning home after visiting the street market. This is a resettlement colony—many people have moved here to make way for the many new infrastructure projects being built in Kolkata such as restoring canals, new flyovers, and the elevated metro train. The boundary is the interior of a small furniture shop that can be seen behind the vendor

### *9.3.1 Reflection*

Design is a type of excursion and stretching exercise into new interactions between things. Urban ecological design practices need to better augment the visibly sequential, invisibly sectional, fine, and coarse grain changes described in this section. Geographers Ananya Roy and Aihwa Ong offer the concept of "worlding practices" that are "constitutive, spatializing, and signifying gestures that variously conjure up worlds beyond current conditions of urban living. They articulate disparate elements from near and far: and symbolically resituate the city in the world" (Roy and Ong 2011: 13). Inspired by this, urban designers and ecologists might, therefore, resituate their practices in these peri-urban areas and support new associations,

**Fig. 9.13** Horizon. This scroll connects three scenes that hold a long view—a precious experience in Kolkata. The *left* scene is a pond that is surrounded by housing colonies. Small urban ponds are used for washing, fish farming, submersion of idols, and fire fighting, and as biodiversity hot spots; however they can get overly polluted in the absence of a caretaker such as a temple or club, and some simple rules. Clothes have been left out to dry along power lines that offer an ample expanse for stretching out a sari. A paved path along the edge of the pond has been swept and is a convenient place to park a motorcycle. The boundary is sunset, the loveliest time of the day for a stroll next to a pond. The *middle* scene is a new wide and straight road that cuts past the edge of a village pond. A man is building a goddess by hand, and others are bathing at the end of the day. At the end of the road is an elite high school, and behind the pond is a multi-tower, high-rise, nonresident-Indian (NRI) complex called Urbana. The prosperous middle class enjoys the East Kolkata Wetlands from air-conditioned comfort. The boundary is tilled soil. The *right* scene is a fish farm. A curious buffalo wanders from behind fishing nets drying in the sun. A dirt path leads to a village, over a little bridge, and further to the next village, and the next village. There are few roads here. The boundary is a basket of small fish, caught very early in the morning, and being carried by foot to a nearby market

contests, and geographies against and beyond environmental unsustainability and inequitable socio-morphological change. The paired research case studies in this section have been designed to open up, through visual reassembly and narrated description, moments for urban practice in the metamosaic. A successful result would be multiple tangibly unconventional spatial expressions of power and knowledge that support equitable public realms in formation.

It is important to foster ways that people can recognize the ecology of the city and not just ecology in the city (Pickett et al. 1997). The search is not to find or create the best patch mosaics and make them function in the most resilient ways according to a set of best management practices. Instead, the paired research

**Fig. 9.14** Pose. This scroll connects three studies of famousness, of scenes that have become commodities. The *left* scene is a brand new eco-park. Smile poses on the waterfront promenade; she has a hat and an umbrella because having white skin is important to her boyfriend. A new pagoda provides a 360° panorama, a destination for lovers, friends, and families. There is also a constructed wetland, gift shop, restaurant, and a big parking lot. A village was demolished in order to create this eco-park. The boundary is a street scene in the central government district that is located in the center of this new town. The *middle* scene is a water village with white buildings with tiled roofs, an enchanting arched bridge, and ducks. This picturesque view is something that supports tourism in Shaoxing with its sightseer boats that ply its many canals. In this village many people have left and it appears abandoned. New factories surround it. The boundary is a rural factory that recycles textile scraps—a type of rural industry in the village. The *right* scene is a fish farmer feeding his fish. The boundary is a tiled façade of a new rural house. The elegant poise of the farmer seems timeless, as if from a famous Chinese painting

described and illustrated in this chapter support the patchy transformation of urban ecosystems according to the environmental and social realities of their inhabitants coupled with actual ecological data created with, from, and for the residents of that place in formation. This is therefore a porous approach that affords a discursive realm, where issues can be defined locally and addressed (or ignored), continuously. It is an approach to urban design practice that permits a diversity of research questions to emerge from overlapping adjacent, and quite similar urban processes; it allows for contesting views and practices to coexist, allowing democratic politics to arise quietly and incrementally through persistent questioning of environmentally unsustainable processes, strategies, and spaces as well as supporting projects, actions, and infrastructures that inspire.

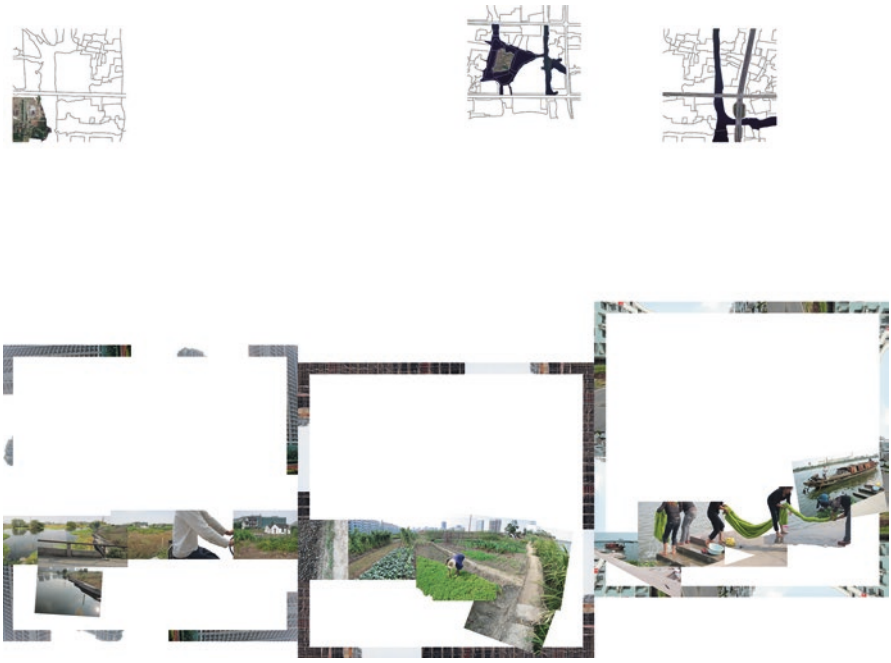

**Fig. 9.15** Persistence. This scroll connects three resettlement cultures. The *left* scene is a demolished water village. A man rides a bike over a bridge and past a stone canal edge, and some isolated farmhouses. In the distance is a stadium complex, part of the recreation and entertainment zone that this area is transforming into. The boundary is an office tower in the central government district that is located in the center of this new town. The *middle* scene is a market garden. A man is tending his allotment that is made of neat rows of vegetables and narrow dirt paths. It is next to a low-rise farmer resettlement housing estate. The boundary is a new residential tower that is being built nearby. Gardeners move their gardens to new plots, as the new town is built, according to a set of locally brokered agreements. Most gardeners are elderly, and possibly former farmers. The *right* scene is about washing clothes in the canal. Two women wring a bed sheet while a boat goes by with two men who are foraging for scrap metal along the shore. This waterfront promenade is new and it was designed with steps to allow for washing clothes and vegetables. The boundary is a housing estate where the women live. It is the same estate as the gardener, and the same canal as described in the next scroll

Paired research is engaged here to open a type of communication that does not currently exist. Effort has been made to not flatten the complexity of forms, systems, and practices in order to fit one into the lens of the other. Nevertheless, when one condition emerged in the research process a search for a corollary was a normal impulse and served to expand and then bracket the research project. The case studies are regional perspectives that are based on socially engaged ecology frameworks, theories, and practices. They have been designed as shared tools for critical practices of democratic visuality, informed ecological spatial imaginaries, and action (Marshall 2014).

**Fig. 9.16** Shiftwork. This scroll is a walk through an industrial zone on a Sunday. The *left* scene is a new megablock intersection, with a billboard announcing an even bigger intersection planned for nearby. The scene has that special mix of peaceful undercapacity that fills such mega zones when they are brand new. Imagine the calm before a storm. The border is a pile of rice wine jars, a famous product particular to this region of the mega delta. Today the factories manufacture paper and textiles, industries that similarly need a lot of water. The *middle* scene is a vendor on the roadside near a small electronics factory that operates 24 h a day. The workers are enjoying fresh, hot noodles for breakfast, and a break in their 12 h shift. The boundary is a wall of handwritten phone numbers that advertise services or products. These signs are often seen near the smaller rural factories in China. The *right* scene is a water highway that is part of the Zhejiang Inland Waterway Renaissance Action plan. Fishermen using hand nets float by big green traffic signs that provide directions for boats, to guide them to nearby ports such as Shanghai. The boundary is a small canal-side port facility, with piles of sand, new warehouses, and *red* cranes

## 9.4 Conclusion

In this chapter, I have argued that cocreated models of patch dynamics can address environmental unsustainability in peri-urban wet landscape environments in India and China. I have shown a design project that translates a spatial framework that is shared by ecologists and designers into visual tools so that a systems approach to studying urban ecologies might better shape the public realm. I drew patch dynamic boundaries and created drawings that illustrate peri-urban change. In addition, I complemented this with a narrative of wet landscape non-linear urban transitions. I assembled and sorted scenes that were the outcome of extensive and repeated


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**Fig. 9.17** Caption for the figure available on p. 228

**Fig. 9.17** Metamosaic India. In this drawing the ecosystem boundaries are scaled to illustrate the relation of each scene to its area of concern. They are described here as follows. (*A*) The interior of the furniture shop in the resettlement colony is a personal site of concern for the livelihood of a family. The shop is one shack on many that form a new commercial street that is the main corridor for the new colony. The colony is distant from the main road, and the surrounding land that is used as a cricket field is also a staging ground for precast concrete elements for a new bypass. This is state land and several very large ponds were filled in to create this area. (*B*) The woman carrying firewood amongst the multifamily homes is witnessing parcel-by-parcel change of land from rice paddy to middle-class colony and adjusting her foraging practices accordingly. She may be someone who lives in the village nearby. How does she know which farmlands or gardens are open to her for foraging? How far does she walk? (*C*) The cooperative that manages the eco-park built a fence around the property to increase its value as a special recreation destination and to protect it from encroachment by the owner, which is the state. In addition environmental activists monitor this pond, and many other water bodies on this eastern edge of Kolkata. This is an unusually large pond, and it is therefore considered highly vulnerable in as it is extremely difficult to assemble very large plots of land for development here. (*D*) The workers and families who created the plastic recycling compounds and leather-paved roadsides have shaped a type of specialized linear recycling district, which both serves to reduce landfill waste and relies on the waste that is created by residents and businesses in Kolkata toward the west, as well as the industries at the Calcutta Leather Complex toward the east. This linear recycling district is aligned adjacent to the main sewage canal as well as the only main road that bisects the East Kolkata Wetlands. (*E*) The owner of the basket of fish might be concerned with the timely delivery of quality wastewater to his ponds. Many canals channel these blackish smelly streams toward the east where there is a contest of political favors to obtain its nutrients. Smaller fish are prized by Bengalis both for their sweetness and the belief that younger fish hold less accumulated toxins. (*F*) The drivers drinking tea next to the hospital are part of the new workforce of the linear road-based urban corridor that is the Eastern Metropolitan Bypass. Significant air pollution and medical waste are two new flows that the much-celebrated East Kolkata Wetlands recycling system can't absorb. There is need of a parallel sanitary-city infrastructure for removing heavy metal contaminants, and disposing of hazardous waste. (*G*) Beholding sunset next to a pond is a precious experience that is repeated at many ponds in the mega delta. Ponds are also used for bathing and for exercise. For example, ponds with paths around them are used each morning and evening for casual social strolls, purposeful walking, as well as stretching and breathing exercises such as yoga, and laughter yoga. Other ponds are used as sites to dump household and construction waste and are therefore sites for foraging and protest. Similar to parks, each pond has a certain mix of men and women that create and protect them as type of commons. (*H*) Tea stalls with clay or plastic teacups are found throughout Kolkata. The teacup kiln village is at the intersection of a debate between hygiene, taste, and tradition. Plastic teacups are discarded in the gutter, swept into piles at the end of the day, and are lit to form little chemical bonfires. Clay cups are considered less hygienic, but more *green*. (*I*) The goddess maker next to the pond displays his trade and craft in anticipation for the festival. His deities are purchased and installed in a neighborhood (*para*)—and are later transported and immersed in the Ganga ceremonially, and then recycled by others

fieldwork. The scenes are composed movement images of everyday life that are framed, named, and narrated in such a way to form a provisional catalog of situated environmental subjectivities. The scenes are, therefore, examples or possible entry points for a resident, designer, or researcher to ask more questions in order to advance meaningfully situated urban ecological design research questions. The scrolls made of scenes as well as the metamosaic drawings are composed so that various urban actors can view their environmental realities in relation to others, as well as within patchy land cover dynamics that have specific forms that shape unsustainable effects in ways that are important to know better.

In the Ganges-Brahmaputra-Meghana mega delta, the patchy heterogeneity explored in this chapter is found on the edge of the big cities such as Kolkata and Dhaka and the port, trading, and regional towns that are part of the old train network and along a few new highways. In Shaoxing, patchy peri-urban heterogeneity is being formed in the scattered areas between the old and new cities that are arranged like a net across Yangtze-Qiantang mega delta and are connected by many new highways and fast train corridors. Kolkata and Dhaka have more megacity model urban processes, and Shaoxing has more megalopolis model urban processes; however, village city systems and land cover heterogeneity completely encompass both mega deltas. The patch, scroll, and metamosaic conceptual tools and drawing methods could be applied anywhere in the mega deltas; however, they are engaged here as paired research located in peri-urban mega delta landscapes because this specific type of urban heterogeneity hasn't been fully explored, and it is where inequalities are most evident. In addition, it is a significant type of village city urban form for emerging open society and global civil society to know better. For this reason, it is important that they support critical urban ecological design research practices in India and China that are being shaped in response to peri-urban environmental unsustainability.

Urban ecology has been defined mostly by ecosystem scientists and less so by urban designers. This chapter critically elaborates an ecosystem science framework and integrates it as a socially engaged urban design and ecology practice with the intent of making sensible the combined actions and effects of open society and global civil society to change environmental unsustainability. When design is located in relation to ecology and politics in this way, it is a contribution to the public realm. To focus on the village city mix is to bring all urban forms, land covers, and experiences of the mega delta into situated focus. In addition, to design with ecology, ecosystem boundaries, and aerial imagery in this way is to advance participatory practice in critical ways. Might the next Indian and Chinese urbanisms be shaped and augmented in a nonlinear context of diverse engagement? Might the village city systems that are a moving mix full of subtle nuance and conflict become no longer a chaotic peripheral vision but rather form a central figure against unsustainable environments? Toward this goal, India and China in this chapter are situated in a hopeful lens and connections have been made between everyday life and the epic civilizational sphere in order to create tangible possibilities for seeing our urban futures differently.

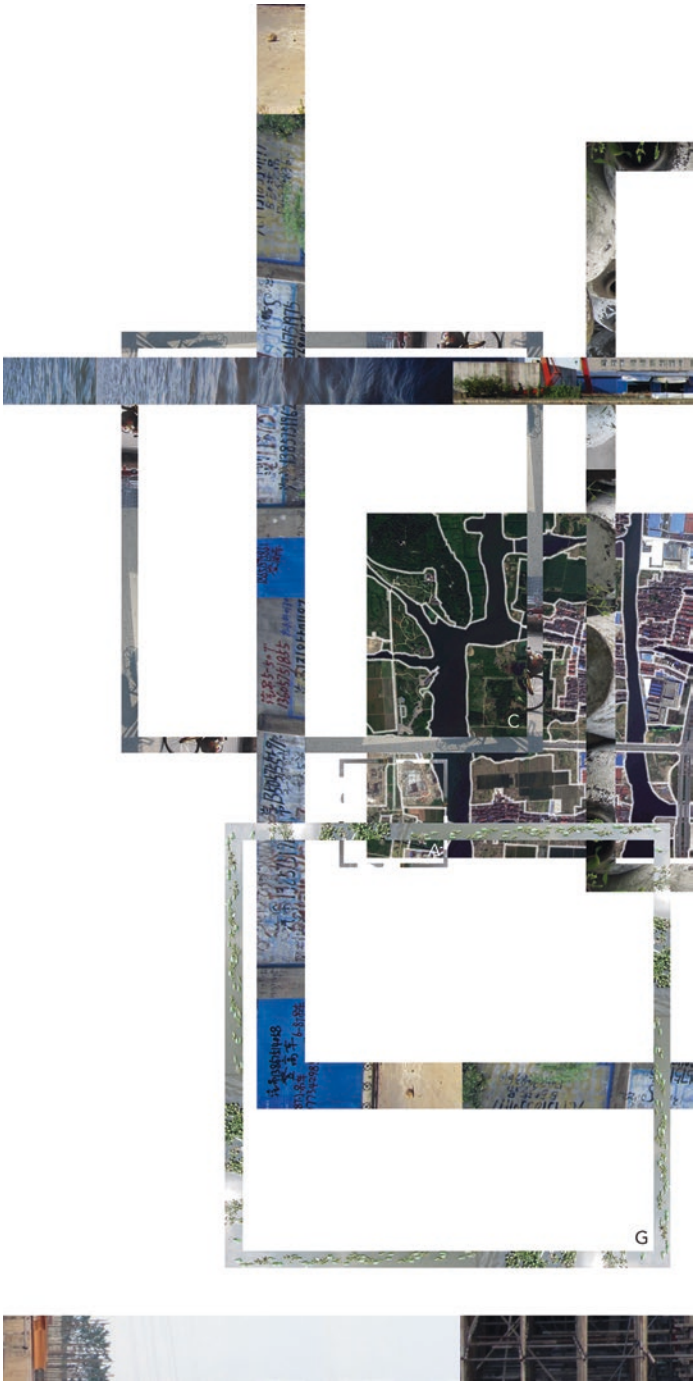
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**Fig. 9.18** Caption for the figure available on p. 232

**Fig. 9.18** Metamosaic China. In this drawing the ecosystem boundaries are scaled to illustrate the relation of each scene to its area of concern. They are described here as follows. (*A*) The man on the bike lives in one of the few houses remaining in this area. His family raises ducks and offered to cook lunch for curious foreigners who were passing by. It is rare for ordinary homes to remain in new town zones like this. His area of concern might be his new home, its location, and opportunities to find work or education nearby. (*B*) Shaoxing is famous for its rice wine. The woman crossing the megablock intersection is part of the new economy workforce for this area that has replaced the rice farmers and wine makers that made a living from the land and water and Jiangnan market-town network. Factory work today is linked to global markets and the port of Shanghai. The vegetative strategy employed here is now based on the reasoning of buffers and beautification of the industrial park. (*C*) The eco-park is a new type of landscape project that is a hybrid between an entertainment park and nature reserve. In addition, landscapes such as this are designed to function ecologically in order to clean water and the air, and act as an education resource. In this new town, that is a mix of demolition and construction, it is one of the few completed projects. (*D*) It seems that fish farms can be moved. They are made of bamboo posts and nets, rather than ponds, as in Kolkata. While many farms have been removed, many also remain. The farmer feeding his fish from his boat lives in a modern village and the quality of the water is critical to his livelihood, in this increasingly industrial shoreline. (*E*) Walking through the village with the arched bridge felt like a visit to an evacuation zone; however there is life, such as elderly people and small-scale factories that print paper placemats and recycled textile scraps. On Sunday families return to the village to visit parents and grandparents and floating gambling barges serve wine and cater to workers. (*F*) Micro-economies are linked to the new factories. The vendor served fresh noodles that were neatly arranged in portion-sized bundles. While the workers were eating a man nearby began foraging through a pile of rubble and wood scraps. He was foraging and was soon asked to move on by a factor guard. The cell phone numbers that are written or posted on walls, poles, and anything vertical also form this landscape of work. (*G*) In the mega delta there is a special type of small canal called a *lou* and this is where people might wash clothes or vegetables. The women washing their sheet on the main canal are from a village and live in this resettlement complex. Further along the canal a man was long-distance swimming, for exercise. Similar to the fish farmer, they might be concerned about water quality. (*H*) Small market gardens are also called peri-farms. The concern is with soil quality, proximity, and theft. In some large farms there seems to be a gatekeeper, someone who others entrust to be present. Other farms seem more precarious such as those that are tilled on freshly excavated soil immediately adjacent to a main road. On the other hand some are less collective, such as those found next to bridges that are also home for the gardener. (*I*) Some canals are being widened, and realigned in order to accommodate larger and faster barge traffic. The fishermen in their boats are floating in the canal, using a simple paddle to gather fish in their underwater nets. There are large tide gates that separate this water from the sea, and so these canals are a type of hybrid, a fishpond and a water highway. How might these two systems coexist?

**Acknowledgements** Thank you to Malgorzata Osinska and Shiladitya Basu for their fieldwork assistance in Shaoxing and Kolkata, respectively. Thank you to Colin MacFadyen and Mikaela Kvan for their excellent assistance in creating the patch drawings. Thank you to Li Ling and Lei Xu for introducing me to Shaoxing. Some material in this publication is based upon work supported by the National Science Foundation under Grant No. DEB-1027188.

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# Chapter 10
# Conclusion

**Jayanta Bandyopadhyay, Sanjay Chaturvedi, and Shikui Dong**

**Abstract** The growing political-economic clout in China and India is yet to be fully reflected and realized in either reforming institutions or making norms. The regional and global responsibility that accompanies their rise in international system further compels China and India to strengthen the collective pursuit of finding common innovative solutions to multi-scalar and incremental environmental challenges.

**Keywords** Environmental sustainability • Euro-centric approaches • Planetary Powers • Social innovations • Techno-scientific approach

China and India, the "Civilizational Twins of the Himalayan Sphere" over millennia and the "Planetary Powers" of today and tomorrow, as territorial nation-states with 2.7 billion people, stand at a crossroad. One heavily treaded path, characterized by continuous growth in material consumption, consumerism and supported by spectacular advancements in modern science and technology, is popularly described as "development." The main thrusts and direction of such "development" is increasingly being dictated and driven by the market. Consequences of having followed this path are getting expressed through widespread destruction of the natural environment, exemplified by some of the most polluted cities, rivers and large areas of coasts, alarming loss and degradation of forest land and biological diversity. At the social dimension, the impacts of treading this path have manifested themselves in the form of forced migration, dislocation, and displacement, often leading to

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S. Dong et al. (eds.), *Environmental Sustainability from the Himalayas to the Oceans*, DOI 10.1007/978-3-319-44037-8_10

marginalization of millions of poor, bordering on destitution. Women, especially those belonging to economically weaker sections of society, pay a disproportionately heavier price for these marginalizing and disempowering impacts.

The other path, largely uncharted, could lead to a radically different state of future that not only promises but also actually delivers more equitable outcome of human economic activities together with ensured environmental sustainability and social justice. No doubt science and technology remain central to realizing such a future but their nature, thrust, and purpose would be directed more towards waging battles against poverty and unsustainability than be driven by military objectives or market forces. Rather than remaining the exclusive domain of a privileged few, a more inclusive knowledge society would be well within the reach of all people. This is because knowledge in its diverse meanings has increasingly become a key factor in shaping the nature of emerging open societies and the global civil society.

This book has, with its case studies, (a) revealed the redundancy of the traditional model of "development" and the extensive damage it has caused to both natural environment and social fabrics from the Himalaya to the Oceans and (b) reinforced the imperative of thinking and behaving differently in order to give a new meaning to "modernity," "sovereignty," and "security." The book on the whole has also emphasized the need to revisit the theories of environmental sustainability through the prevalent practices. A specific appeal has been made to question Euro-centric approaches to understand urban transformation in China and India that fail to fully capture the complex and dynamic rural-urban blend.

Through this book we have made an attempt to demonstrate that geographies, physical and human, do matter and will continue to do in the realization of environmental sustainability. Despite commonality of certain aspects of the problematic, a fit for all "innovative" perception for diverse landscapes connected by river flows in this book—from mountain grasslands to flood plains of Himalayan rivers to the urban settlements to the remote farming areas to mangroves and estuaries (Fig. 10.1)—is highly unlikely to deliver expected outcomes. In short, both space and place with their specific locations and characteristics are inconsistent with highly generalized notions of environmental sustainability. Equally problematic is the application of conventional geographical scale to flows of materials and human.

One of the major features of growth-obsessed perception of human economic activities, now increasingly putting up a "Green" face to avoid criticism and condemnation from the civil society and the voluntary sector, is the divorce of social from ecological. This has facilitated a more market-driven, techno-scientific approach to environmental sustainability that leaves largely unaddressed the gap between the scientific and the cultural understanding of natural environment. A collective note of appeal is sounded in this book in favor of bridging this gap by emphasizing the central and strategic importance of social innovation as the fulcrum around which various other approaches to environmental sustainability, including legal and institutional, could revolve.

One of the key defining criteria for an innovation to qualify as social innovation for environmental sustainability is that it should promote public interest rather than

**Fig. 10.1** Landscape of the Himalaya-to-Oceans (drawing by Victoria Marshall)

private interest. What qualifies as common good should be decided through conversations rooted in a dialogic process and democratic culture rather than dictations from above. Both in China and India we find long-standing traditions of argument, protest, and resistance. These traits continue to oppose the gradual erosion of the social in the dominant developmental discourses. The steady loss of the social in all its diversity does not bode well for environmental sustainability. Equally worrisome is the push of the market forces towards the politics of the apolitical. As shown by the chapters in this book, in both China and India, the number of struggles in the form of social–environmental protests and movements is one the rise, demanding information symmetry, transparency, and participatory decision-making. The system of public interest litigation introduced in India exemplifies a judicial innovation to protect and promote the social space.

The challenge of finding innovative solutions to the problem of environmental unsustainability in China and India is compounded by global power-political transformations, on the one hand, and the dominance of Euro-centric experiences and understandings of environment, and "environmental movement," on the other. The growing political-economic clout of these two large Asian countries is yet to

be fully reflected and realized in either reforming institutions or making norms. The regional and global responsibility that accompanies their rise in international system further compels China and India to strengthen the collective pursuit of finding common innovative solutions to multi-scalar and incremental environmental challenges such as climate change. The 21st Conference of the Parties (CoP 21) to the UNFCCC, while diluting the principle of "common but differentiated responsibility," has further opened the scope for China and India towards closer collaboration in order to meet the obligations under their respective "Intended Nationally Determined Contributions" (INDCs). This provides a very useful platform for the two neighbors for jointly promoting innovations that would benefit humanity as a whole.

As China and India get their acts together to address the common challenge of sustainable low carbon climate futures, they simply cannot afford to underplay the gravity of current environmental unsustainability. They can see the writing on the wall: *environmentally unsustainable present* can only lead to an *unsustainable climate future*. There is no doubt ample earth and climate science evidence to suggest that millions will be harmed in future, especially in Global South, due to various negative fallouts of climate change, including health. No such evidence is needed to show that millions are already seriously harmed in cities across China and India due to severe air pollution. The Centre for Science and Environment (CSE) in Delhi has been at the forefront of sounding a note of urgency, bordering emergency, with regard to the pace and scale at which air pollution has grown across India. According to a 2015 CSE Report, 10,000–30,000 deaths are caused by air pollution—caused by particles smaller than a virus in diameter—annually in Delhi alone and is the fifth leading cause of death in India. According to yet another study by CSE, Bengaluru city residents breathe in air with 3–12 times higher pollution levels than the ambient level. And in Beijing the first ever "Red Alert" (most serious level for Air Quality Index) was sounded on 8 December 2015, under the four-tier smog emergency alert and response system, which coincided with the 21st Session of the Conference of the Parties under the UNFCCC, held in Paris. A month before that, "the capital [Beijing] saw its readings of PM2.5—hazardous particulate matter smaller than 2.5 microns in diameter—soar to 118 micrograms per cubic meter on average, a year-on-year increase of 39 percent, according to the monthly report released by the Ministry of Environmental Protection" (*China Daily* 18 December 2015). This reading was nearly "seven times the WHOs recommended maximum exposure of 25 over a 24-hour period" (Ibid.).

In both China and India, a number of stringent measures including leapfrogging emissions standards to Euro VI, drastically curbing dieselization, scaling up of integrated public transport, imposing restraints on private cars, and even walking/cycling for clean air are needed. It is to say the obvious perhaps that threats posed by the deadly air pollution are yet another cause and catalyst, among several other highlighted in this book, for cooperation, collaboration and exchange of experiences, knowledges and innovations between the two neighbors. Yet another timely reminder to the two most populous, fastest growing economies with enviable human

capital in a globalizing world that "Rise" comes with enormous responsibility of planetary scale, especially in the era of climate change and growing scarcities of two of the five basic elements of life: clean air and clean water. There is still plenty of hope around both *in* and *about* China and India that these two "Civilizational Twins of the Himalayan Sphere" will rise to the occasion, redefine "development," and dare to think differently and innovatively towards shared sovereignty, common security, and socially just environmental sustainability.

# Index





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# Book Commentaries

This book demonstrates that the social innovations do matter and will continue to do so in the realization of environmental sustainability for two large Asian countries, China and India across diverse landscapes connected by river flows from mountain grasslands to flood plains of Himalayan rivers to the urban settlements to the remote farming areas to mangroves and estuaries. The challenge of finding innovative solutions to the problem of environmental unsustainability in China and India is compounded by social and economic transformations at local and regional scales. This provides a very useful platform for these two neighboring countries for jointly promoting innovations that would benefit humanity as a whole. This book can attract you to read, think, and act right away for promoting the environmental sustainability in China and India, even beyond.

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S. Dong et al. (eds.), *Environmental Sustainability from the Himalayas to the Oceans*, DOI 10.1007/978-3-319-44037-8

The future of global sustainability depends on how China and India develop in the decades ahead. This book represents an important contribution to understanding and promoting environmental sustainability in a millennial context in these two 'civilizational twins', with ecosystems that depend on the 'Himalayan water tower'. I am very pleased to see the publication of this timely and productive book, given the pervading sense of urgency in the era of extensive environment degradation, especially climate change. It provides new insights on environmental sustainability from Himalayan grasslands to the coastal areas, linked by Himalayan rivers, and rural and urban landscapes in China and India. I highly recommend this important publication to researchers, designers, planners, policy makers, students, and others who are working on environmental sustainability in China or India and worldwide.

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Over the past decade Professor Dong has successfully broadened his ecological focus on grassland management in China to embrace the complexities of the social-environmental nexus and to encourage trans-disciplinary collaborations that are essential to eventually realizing sustainable development worldwide. Here, Dong and colleagues provide a unique and useful interdisciplinary synthesis of the social-environmental challenges and their possible solutions across a major geopolitical landscape. I can think of no more complicated, or more important, setting for a consideration of environmental sustainability than the mountains to oceans continuum that spans the rapidly developing countries of China and India. This volume provides a solid foundation for stimulating that important discussion.

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