Chapter 1
Mangroves in Asia-Pacific: A Review of Threats and Responses

Rajarshi DasGupta and Rajib Shaw

Abstract The Asia-Pacific region is among the world's most sensitive regions to climate change because of its topography and relatively high density of underprivileged population in low-lying coastal areas. It is estimated that 1-m sea-level rise by the end of this century would displace approximately 24 million people in Bangladesh, India, Indonesia, Cambodia, Vietnam, and the Philippines. The scenario is further escalated by the loss of vital ecosystem services in coastal areas. Most important of all are, perhaps, the mangroves. Despite of hosting nearly half of the global mangroves, the region continues to loose mangrove forests faster than any other places in the world. While at present the loss is mostly aggregated by unsustainable human practices, climate change is also expected to play an adverse role in the near future. The potential consequences may lead to faster erosion, submergence under the rising sea, and discontinuation of a plethora of ecosystem services that are fundamental to coastal communities. This introductory chapter reviews the exiting conditions of Asia-Pacific mangroves with country-level analysis of threats and institutional response mechanism. The chapter also briefly narrates the scope and expectations from this book.

Keywords Mangroves • Conservation • Asia-Pacific region • Climate change • Sustainability

1.1 Introduction

Climate change is no longer a future threat, but a harsh reality for the billions of people living in the Asia-Pacific region. Evidence of prominent rise in the intensity and frequency of many extreme events including tropical cyclones, intense rainfall, tornadoes, droughts, thunderstorms, etc. are indicative of a perilous future, and as

R. DasGupta (✉)
Graduate School of Agriculture and Life Sciences, The University of Tokyo, Yayoi 1-1-1, Bunkyo-ku, Tokyo 113-8657, Japan
e-mail: rajarshidg1@yahoo.co.in

R. Shaw
Integrated Research on Disaster Risk, Beijing, China

R. DasGupta, R. Shaw (eds.), *Participatory Mangrove Management in a Changing Climate*, Disaster Risk Reduction, DOI 10.1007/978-4-431-56481-2_1

predicted, the existing situation is much likely to aggravate within few decades or so (Hijioka et al. 2014). Moreover, an alarming trend of global warming (GW)-led sea-level rise possesses one of the gravest challenges for the Asia-Pacific region since vast low-lying coastal areas, including densely populated large river deltas, will eventually get inundated under the rising sea. According to IPCC, by 2050, sea-level rise in the Ganges-Brahmaputra-Meghna (GBM) delta in Bangladesh could directly displace more than three million people and up to seven million people living along the Mekong delta in Vietnam. In particular, with its archipelagic landscape along with large section of communities living in the low-lying coastal areas, Southeast Asia remains typically vulnerable to these predicted changes (World Bank 2013). Cumulative and cascading impacts of climate change, including the observed trend of sea-level rise, may well displace roughly 24 million people in Bangladesh, India, Indonesia, Cambodia, Vietnam, and the Philippines by the end of this century. In the wake of such situation, governments and communities across the Asia-Pacific region need to find suitable measures that can defy, or at least minimize, the predicted consequences.

Ecosystems offer significant opportunities for climate change adaptation/mitigation, by providing range of services including support for livelihood, food, fodder, nutrient recycling, flood retention, storm surge protection, and many more. Since the publication of "Millennium Ecosystem Assessment" report (2005), there has been massive recognition of the importance of healthy ecosystems and its profound role in climate change adaptation/mitigation (Uy and Shaw 2012). Consequently, Ecosystem-based Adaptation (EbA) emerged as one of the potential adaptive strategies which essentially relies on the use of ecosystem services and biodiversity as a part of overall adaptation strategy to negate the adverse effects of climate change (CBD 2009). Yet, despite its enormous possibilities, grave scenario of major terrestrial and marine ecosystems across continents considerably limits its prospects (MEA 2005; CBD 2009). In particular, conditions of marine and coastal ecosystems remain heavily altered in the Asia-Pacific region due to tremendous population pressure, overexploitation, rapid urbanization, and a multitude of other anthropogenic and environmental factors. Rejuvenation of these ecosystems and its long-lost services, therefore, remain highly imperative from the perspective of fostering climate resilient communities and to promote Ecosystem-based Adaptation in this extremely vulnerable region.

Mangroves are the assemblage of trees and shrubs that grow in the intertidal region of tropical and subtropical coastline, typically occupying the coastline between 30° Northern latitudes to 30° Southern latitude. Together, they form a unique and highly productive coastal ecosystem and provide a range of indispensable environmental and economic services. They can survive under high salinity, extreme weather, powerful tides, strong winds, high temperatures, and muddy anaerobic soils (Kathiresan and Bingham 2001; Selvam and Karunagaran 2004). Mangroves provide roughly 70 valued ecosystem services that are essential to human well-being, and many of these services such as sediment accumulation and storm surge reduction are pivotal for climate change mitigation/adaptation and disaster risk reduction in coastal areas (Dixon 1989; Kathiresan 2012). In

general, ecosystem services of mangroves have been broadly classified as *provisioning services* (e.g., timber, fuel wood, wax, honey, charcoal, etc.), *regulating services* (e.g., flood, storm and erosion control, prevention of salt water intrusion, carbon capture and storage, sediment trapping, etc.), *habitat services* (e.g., breeding, spawning and nursery ground for fishes, biodiversity), and *cultural services* (e.g., recreation, religious, and aesthetic) (Vo et al. 2012). Particularly, their exceptional ability to survive in harsh environmental conditions makes mangroves an exclusive choice for Ecosystem-based Adaptation in vulnerable coastal areas. Nevertheless, despite of immense ecological services, like many other tropical and subtropical ecosystems, mangroves have undergone widespread damage mainly due to anthropogenic interventions. For example, Duke et al. (2007) mentioned that mangroves are among fast-disappearing ecosystems and dwindling at an alarming rate of 1–2 % every year. They also feared that the ecosystem services provided by mangroves may well be lost within the next 100 years (Duke et al. 2007). Nonetheless, over the past decade, a renewed interest in mangroves halted this massive rate of annihilation, and a numbers of restoration projects have been attempted by various governments as well as nongovernmental organizations (NGOs). Particularly, restoration of mangroves have become central strategy for many international projects/initiatives such as Mangroves for the Future (MFF), REDD (Reducing Emissions from Deforestation and Forest Degradation), "Blue Carbon Initiative." etc.

This chapter essentially caters to two specific objectives. Firstly, we aim to provide a rapid overview of occurrence and distribution of mangrove ecosystems, its historical and current extent, threats, and measures taken up for mangrove conservation by the respective governments within the Asia-Pacific region. We also provide a comparative analysis among the countries with significant mangrove extent in terms of adequacy and effectiveness of legal mechanism for mangrove conservation and briefly narrate the lacunas of the existing policies. Secondly, this chapter delivers the brief narrative of the purpose of this book, with explanation of broad thematic areas, distribution of chapters, and expected readership.

1.2 Current Extent of Mangroves in the Asia-Pacific Region

The Asia-Pacific region corresponds to a vast geographical region stretching northward to Mongolia, southward to New Zealand, eastward to the island states of Oceania, and westward to Pakistan (*see* Fig. 1.1). The region hosts approximately 30 countries that cover nearly half of the world's population. Biogeographically, the region overlaps with the exceptionally diverse Indo-West Pacific mangroves. According to the latest estimations, mangrove cover extends to nearly 77,496 sq.km which accounts for nearly half of the global extent of mangroves (Spalding et al. 2010). Mangroves in the Asia-Pacific region fall under two distinctive ecoregions,

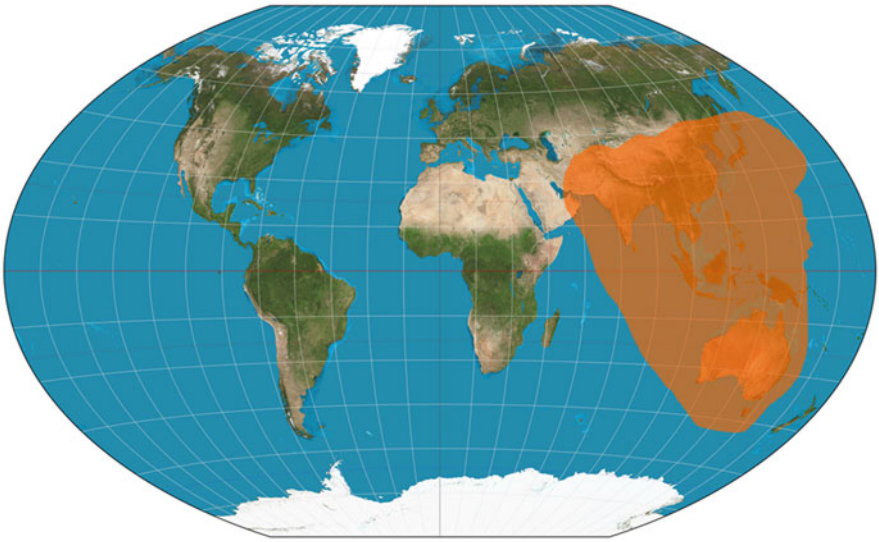

Fig. 1.1 Location map of Asia-Pacific region (demarcated by Orange boundary)

i.e., "Indo-Malayan Ecoregion" and "Australasia Ecoregion". Mangroves occupying these regions are further categorized into several subregions as depicted in Table 1.1. It is to be noted that the information provided in Table 1.1 have been compiled from various reports and statistics, hence might not be extensive. However, the table provides a quick overview of the extensive regional dominance of mangroves.

Historical documentation related to mangrove cover in this region is not extensive, although it is believed that more than 75 % of the tropical coastline in the region was once covered by mangrove forests. However, owing to extensive human pressure, especially from agricultural growth in coastal areas and lately due to expansion of aquaculture, mangrove covers declined to more than 35 % since the 1980s (Giri et al. 2011). United Nation's Food and Agricultural Organization (FAO) reported that within the South and Southeast Asia, nearly 1.9 million hectare of mangroves was deforested during 1980–2005 (FAO 2007), of which, majority of the loss can be accounted from countries like Indonesia, Myanmar, and Pakistan. On the contrary, mangroves from Bangladesh remained mostly intact during the similar period.

In the Asia-Pacific region, Indonesia alone accounts for 20.9 % of global mangroves, followed by Australia (6.5 %), Malaysia (4.7 %), Myanmar (3.3 %), Bangladesh (3.2 %), and India (2.8 %) (Spalding et al. 2010). Several other South and Southeast Asian countries such as Thailand, Vietnam, Cambodia, Sri Lanka, and Singapore, as well as Papua New Guinea, New Zealand, and Pacific Island states also have significant amount of mangroves. Nevertheless, as mentioned, over the previous three decades, the region also registered highest loss of mangroves due to continued human intervention. Degradation of mangroves in the region has been

Table 1.1 Mangrove ecoregions in the Asia-Pacific

	Indo-Malayan ecoregion						Australasia ecoregion		
Mangrove ecoregion	Indus River Delta (a)	Godavari-Krishna mangroves (b)	Sundarbans mangroves (c)	Burmese Coast mangroves (d)	Indochina mangroves (e)	Sunda Shelf mangroves (f)	New Guinea mangroves (g)	Australian mangroves (h)	New Zealand mangroves (i)
Type	Backwater-estuarine	Deltaic/estuarine	Deltaic	Deltaic and coastal	Coastal	Coastal	Deltaic and coastal	Estuarine/ coastal	Estuarine/ coastal
Dominance	Transboundary	Domestic	Transboundary	Domestic	Transsboundary	Transboundary	Transboundary	Domestic	Domestic
Major river	Indus	Mahanadi,	Ganges,	Ayeyarwady	Mekong,	Mahakam River	Fly River Sepik River,	Daintree River	Waikato River
		Godavari,	Brahmaputra,						
		Krishna	Meghna		Red River				
Mangrove diversity	Very low	Low to moderate	High	Moderate	High	Very high	Very high	Very high	Very low
Total habitat area (sq. km.)*	5250	7000	25,000	3822	26,936	40,000	26,800	11,500	220
Protected area (sq. km.)*	823	920	2700	125	820	6530	8770	1000	N.A.
Occurrence	Western of India and eastern coast of Pakistan	Eastern coast of India (Orissa to Tamil Nadu)	Bangladesh,	Myanmar,	Thailand (east coast),	Eastern Malaysia,	Indonesia,	Australia	New Zealand
			India	Thailand-West coast	Cambodia,	Indonesia,	New Guinea,		
				Peninsular Malaysia	Vietnam,	Brunei	Pacific Island states		
					Malaysia,				
					the Philippines				
Status	Critically degraded and fragmented	Degraded	Degraded	Critically degraded	Critically degraded	Degraded	Degraded	Degraded	Degraded

Source: *Figures provide close approximation (Modified from DasGupta and Shaw 2013a)

a result of continuous developmental pressure exerted on the coastal areas. For example, historically a number of megacities in the region such as Singapore, Jakarta, Bangkok, Manila, Yangon, Kolkata (Calcutta), and Mumbai (Bombay) were built over erstwhile mangrove forests. However, within the recent era, agricultural expansion and coastal aquaculture development have been identified as two primary factors of mangrove deforestation. In addition, climatic and other environmental factor may also trigger loss of mangroves in near future. Table 1.2 summarizes major impounding factors against specific mangrove ecoregions in the Asia-Pacific region.

Agricultural expansion into mangrove ecosystems has a long history in South and Southeast Asia. For instance, historically, more than 150,000 ha of mangroves were diverted for agricultural land in Sundarban Delta (DasGupta and Shaw 2013b). Similarly, rice cultivation accounted for massive reduction of more than 50 % of Ayeyarwady delta mangroves in Myanmar. Similar examples can also be cited from Mekong and other large river deltas in the region. Giri et al. (2008), based on their study using satellite remote sensing, mentioned agricultural expansion (81 %), aquaculture (12 %), and urban development (2 %) as the three major determinants for mangrove forest annihilation in the Indian Ocean tsunami-affected countries. This includes Indonesia, Myanmar, Thailand, India, and Bangladesh. In particular, Myanmar registered the highest rate of mangrove annihilation, whereas mangroves of India and Bangladesh remained mostly intact during 1975–2005.

Nonetheless, compared to agriculture, aquaculture is more recent and hasty driver of mangrove forest degradation almost all across the South and Southeast Asian countries. Coastal aquaculture, particularly tiger shrimp cultivation, is the second largest anthropogenic cause of mangrove deforestation in South and Southeast Asia. The process of shrimp farming is economically lucrative and ensures high return on investment within a short period of time. During the late 1980s, skeptic rise in global price of commercially produced shrimps led to massive expansion of coastal aquaculture, which in due course of time took the shape from a traditional practice to an unsustainable polluting industry. Globally, about 75 % of commercially produced shrimps come from Asia and Thailand being the second largest exporter after China. Giri et al. (2008) mentioned that since 1975, approximately 41 % (18,816 ha) of Thailand mangroves, 63 % (20,956 ha) of Indonesian mangrove, 22 % (7554 ha) of Indian mangrove, and 11 % (1070 ha) of the Bangladeshi mangroves were diverted to shrimp ponds.

Apart from these two major delineating factors, massive population growth and rapid industrialization of coastal areas also lead to significant loss of mangrove habitats. Population expansion also increases the competition over resources such as land, water, etc. For instance, DasGupta and Shaw (2015) mentioned that population growth in the Indian Sundarban delta expanded from 0.29 million in 1872 to 4.37 million in 2011 which continues to squeeze the extensive Sundarban delta mangroves (DasGupta and Shaw 2015). On the other hand, rapid industrialization, especially development of ports and industrial facilities,is of serious regional concern. For example, Port Qasim at Karachi (Pakistan) and Port Mundra in Gujarat, India, are largely criticized of degrading the vulnerable Indus delta

Table 1.2 Factors influencing loss of mangroves in the Asia-Pacific region

	Indo-Malayan ecoregion						Australasia ecoregion		
Mangrove ecoregion	Indus River Delta (a)	Godavari-Krishna mangroves (b)	Sundarbans mangroves (c)	Burmese coast mangroves (d)	Indochina mangroves (e)	Sunda Shelf mangroves (f)	New Guinea mangroves (g)	Australian mangroves (h)	New Zealand mangroves (i)
Agricultural conversion	+++	+	++	+++	+++	+	+++	+	+
Aquaculture	+	+	++	++	+++	+++	+++	+	+
Clear-felling for wood, charcoal, etc.	++	+	+	+++	++	++	+++	+	+
Marine pollution	++	+	++	+	++	++	+	+++	++
Urbanization and industrialization	+++	+	+	+	++	++	++	+++	+++
Rise in sea level	+	++	+++	+	++	++	+++	+	+
Lack of freshwater, nutrient supply, etc.	+++	+	++	+	++	++	+	+++	+
Storms and surges	+	+	+++	++	++	++	+	+	+

Source: +++ very significant impact, ++ moderate impact, and + low/no impacts

mangroves. Similar instances can also be cited from Paradip (India), Malacca port, and Penang industrial states (Malaysia). Particularly, movement of cargo vessels and oil spillage in the major shipping lines across the Malacca strait, Gulf of Thailand, and South China Sea possess significant threat for mangroves in the adjoining countries. However, considering the magnitude of direct deforestation of mangroves, indirect drivers such oil spillage and environmental population are secondary from management perspectives.

It is largely believed that despite of mangroves' exceptional adaptive capacities, climate and hydrological changes due to global warming will further affect mangrove sustainability in the

region. The primary impacts from climate change include inundation of coastal mangroves due to relative sea-level rise and reduction of species diversity due to unfavorable soil and water salinity. In addition, a series of morphological changes may occur due to subsequent reduction of freshwater flow in estuarine environment. However, it is rather difficult to pinpoint the exact impacts and predicted loss of mangroves purely from climate change perspectives. In most of the cases, these impacts are intrinsically linked to anthropogenic factors, and therefore, it is difficult to isolate the climate impacts precisely. In addition, it might also be possible that mangroves successfully adapt to the changes by landward migration. Nonetheless, it can be summarized that deltaic mangroves remain more vulnerable to climate change impacts. For example, as freshwater flow continues to reduce in major Asian rivers, the problem of unfavorable salinity is looming large on the horizon. In the past, salinity adversely affected the species diversity of mangroves. For instance, mangrove diversity has virtually reduced to only one (*Avicennia marina*) in the Indus River Delta due to unavailability of freshwater. Lack of freshwater flow also leads to poor sediment accumulation in the delta areas, thereby adversely affecting the delta building process. For instance, Lovelock et al. (2015), based on their regional study, mentioned that 69 % of the current mangrove habitats will starve from lack of sediment supply and may well get inundated under the rising sea by 2070. Similarly, many small deltaic islands colonized by mangroves may well be inundated in the future. In the case of coastal mangroves, especially in the Pacific Island states, Gilman et al. (2006) mentioned 12 % reduction of existing mangrove habitats is much likely by the end of this century.

1.3 Conservation and Restoration of Mangroves in the Asia-Pacific Region

Historically, mangroves were mostly considered as wasteland with no economic outputs. This resulted in sharp decline in mangrove habitats almost all across Asia as conversion of mangroves for non-forest commercial purposes were decisively incentivized in most of the Asian countries. However, since the early 1970s, particularly following the Ramsar Convention of Wetlands (1971), conservation

of mangrove received some sort of priority. In the following years after the convention, countries with considerable mangrove extent adopted appropriate legislative arrangements for the protection and conservation of mangroves. Yet, these measures were mostly confined within policy documents since vast majority of the countries, including some of the post-conflict and poorest countries of the region, found it difficult to implement such strategies. Table 1.3 summarizes country-specific legislative arrangements and provisions thereunder which can be utilized for mangrove conservation. In particular, traditional livelihood interests and exponential population growth within the coastal region exerted additional stress on these fragile ecosystems. Nevertheless, as mentioned, following the Ramsar convention, countries like Pakistan, India, the Philippines, and Indonesia formed the National Mangrove Management Committee to promote mangrove conservation (DasGupta and Shaw 2013a). This can be considered among the earliest institutional arrangement specifically aimed at mangrove conservation. However, the Indian Ocean tsunami in 2004 was the major turnaround for the regional advocacy for conservation of mangroves. A plethora of case studies, especially from tsunami-affected countries such as Indonesia, Thailand, Sri Lanka, and India, reported the explicit role of mangroves in tsunami wave mitigation which saved precious human lives during the catastrophic disaster (e.g., Kathiresan and Rajendran 2005; EJF 2006). This renewed national and international interests to conserve mangroves for disaster risk reduction purposes. As a result, mangrove conservation became national priority and an agenda for sustainable development in coastal areas. Countries like Indonesia Vietnam, etc., ratified "coastal green belt" concepts so as to put mangroves as first line of defense. In the following years, higher sense of obligation in terms of conservation and restoration of mangroves has been observed from the Asian countries. In particular, mangroves became very much a part of National Action Plan on Climate Change and other pressing policy agendas for sustainable development. For example, Thailand opted for a minimum 2000 sq.km mangroves policy. while India, under the Green India Mission, planned to increase the current mangrove extent by 1000 sq. km by the end of 2020. In many countries such as Myanmar, Thailand, and Bangladesh, active NGO intervention in mangrove conservation is also a welcome change that had occurred within the past few years.

1.4 Community Participation in Mangrove Management

Approximately 6.9 % of the global mangrove habitats are currently enjoying varied degree of legislative protection (i.e., IUCN protected area categories I–VI) (Giri et al. 2011), whereas majority of the mangroves are still accessible and remain susceptible to continued human intervention. In the Asia-Pacific region, mangrove exists in the form of complex socio-ecological systems which essentially escalate the probability of unsustainable and potentially damaging use of mangroves. Particularly, traditional livelihood dependence

Table 1.3 Legislative arrangement for mangrove conservation

Country	Main governing department	Legislative aspects of mangrove conservation and associated secondary legislation					
		In situ conservation of natural resources	Community participation in mangrove management	Control of shrimp farming	Coastal zoning/ integrated coastal zone management	Marine/coastal environmental protection	Legislative provisions of coastal greenbelt development
Pakistan	Provincial forest departments	**Major provisions in** Forest Act, 1927, and subsequent Provincial Acts	No specific legislative arrangement	No specific legislative arrangement	No specific legislative arrangement	**Major provision in** National Action Plan on Environment	No specific legislative arrangement
India	Ministry of Environment, Forest and Climate Change	**Major provisions in** Forest Conservation Act, 1980 and Wildlife (Protection) Act, 1972	**Major provisions in** Joint Forest Management initiatives adopted by National Forest Policy, 1988	**Major provisions** in Coastal Aquaculture Authority Act, 2005	**Major provisions in** CRZ Notification, 1991 (Rev. 2004) under the Environmental Protection Act of 1986	**Major provisions** in Environmental Protection Act, 1986, Water Prevention and Control of Pollution Act, 1974	No specific legislative arrangement
Bangladesh	Ministry of Environment & Forest	**Major provisions in** Forest Act, 1927 (Amendments in 1989)	**Major provisions in** Forest Policy, 1994 allowing community participation	**Some provisions** in Environmental Regulations, 1997	**Major provisions in** Coastal Zone Policy, 2005	**Major provisions** in Environmental Regulations, 1997	**Some provisions** in coastal development strategy
Myanmar	Ministry of Forests	**Major provisions** in Forest Act, 1995	**Some provisions** in Forest Policy, 1995	No specific legislative arrangement	No specific legislative arrangement	No specific legislative arrangement	No specific legislative arrangement
Thailand	Royal Forestry Department and Ministry of	**Major provisions in** National Forest Reserves Act , 1964	**Major provisions in** Community Forestry Bill, 2007	No specific legislative arrangement	**Some provisions** in Land Development Act, 1983	**Some provisions** Enhancement and conservation of National	No specific legislative arrangement

	Natural Resources and Environment					Environment Quality Act, 1992	
Vietnam	Ministry of Natural Resource and Environment and Ministry of Agricultural and Rural development	**Major provisions** in Forest Protection and Development Law, 2004	**Some provisions** in 2003 amendments of Land Law, 1993	**Some provisions** in Environment Protection Law, 1994 and Land Law, 1993	**Some provisions** in Decree 25	**Major provisions** in Resolution 41/2004 and Environmental Protection Law (revised 2005)	No specific legislative arrangement
Malaysia	Department of Forestry (Provincial Government)	**Major provisions** in National Forestry Act 1984 (revised 1993)	No specific legislative arrangement	No specific legislative arrangement	**Major provisions** in 9th Malaysian Plan (2006–2010)	**Major provisions** Environment Quality Act, 1974 and Merchant Shipping (Oil Pollution) Act of 1994	**Major provisions** in 9th Malaysian Plan (2006–2010)
Indonesia	Ministry of Forestry	**Major provision** in Presidential Decree 32 (1990)/ Law no.5 (1990)	**Some provisions** in 2004 amendments in Law no. 32/41	No specific legislative arrangement	**Major provisions** in Law no 27 year 2008	**Major provisions** in Law no. 32 (2009)	**400 m greenbelt as per** Decree no. H.1/4/2/ 18/1975
The Philippines	Department of Environment & Natural Resource	**Major provision** In Republic Act 7586 (1992)	**Major provision** In Republic Act 8371 (1997)	**Major provisions** in Republic Act 8550 (1998)	**Major provisions** in Coastal Zone Management Plan, 1997	**Major provisions** in Presidential Decree no. 979 (1976)	DENR A.O. 76 (1987) – 50 m coastal greenbelt development

Source: Adopted from DasGupta and Shaw (2013a)

coupled with growing population pressure continues to squeeze the already degraded mangrove habitats and increases competition over these fragile natural resources. Therefore, while adequate institutional priority is essential, it becomes further important to manage the mangrove-dependent communities for enhancing mangrove sustainability. Under this backdrop, governments and policy planners growingly recognize that legislative arrangement alone cannot serve the ambitious goals of mangrove conservation; rather it requires a holistic and inclusive arrangement involving the resource-dependent communities in mainstream forest management. Particularly, active community participation is highly imperative to make sustainable human-environment relationship across mangrove habitats. This has led to significant advocacy for decentralized management of mangroves in recent years, through the intermediation of community organizations, NGOs, civil societies, etc. Many researchers argue that, given the complex scenario of high dependency on mangroves, participatory mangrove management or decentralized approach for mangrove conservation provides an ameliorative approach of conservation compared to traditional hierarchical arrangements.

Over the previous years, participatory mangrove management or community based mangrove management has slowly paved its way into the erstwhile top-down resource management strategy of the majority of the Asia-Pacific countries. Particularly, since the decentralization of forest management in the late 1980s, many countries have adopted participatory arrangement for forest conservation, while many others are currently in the process of decentralizing their state-owned management systems. As argued by Datta et al. (2012), the essence of community-based mangrove management lies in the fact that mangrove sustainability generally follows sustainable communities. In other words, if the economic aspiration and interests of the mangrove-dependent communities are taken care of, it is likely that the concerned communities will actively participate in mangrove conservation. Further, researchers argue that unlike the top-down arrangements, participatory management provides a "win-win" situation for the government and implementing agencies since it advocates for inclusive development, including the economic empowerment of mangrove-dependent communities through sustainable utilization of mangroves and allied resources. Currently, the good number of national and international NGOs, developmental agencies, and UN bodies is advocating and administering projects that involve community-based mangrove restoration in the Asia-Pacific region. It is however important to acknowledge that even with its superiority over the traditional "top-down" resource governance, there are many unsolved issues that are hindering the desired outcome of community-based mangrove management. Although it is difficult to generalize these factors with limited case studies, it is imperative to understand that community-based mangrove management operates within specific social, institutional, and economic boundary conditions. As argued by Datta et al. (2012), mere implementation of participatory arrangement is no guarantee for its success unless it is clear of its objectives, benefit-sharing mechanism, as well as well-defined forest and property rights. Hence, it becomes imperative to analyze the key factors that can be attributed to the success of participatory mangrove management and, therefore, be advocated

across similar socio-ecological systems. The book is essentially dedicated to fulfill this vacuum and aims to understand the key sustainability issues in participatory conservation of mangroves. Relying on shared learning from different country experiences, the book attempts to draw the opportunities and challenges in mangrove conservation in the Asia-Pacific region.

1.5 About This Book

With the above context of participatory management of mangroves, this book presents 20 chapters, including this introductory chapter. These chapters aim to explore country-specific threats and institutional responses, together with specific case studies depicting experiences and learning from participatory arrangements of mangrove conservation from the Asia-Pacific region. The chapters are arranged in terms of biogeographical occurrences of mangroves, starting from Pakistan in the West to Pacific Islands in the Far-East. The book consists of country-specific overviews, policy analysis, as well as case studies from Pakistan, India, Bangladesh, Sri Lanka, Myanmar, Thailand, Cambodia, Indonesia, Malaysia, Japan, and the Pacific Islands. The book caters three specific types of articles, i.e., (a) *overview articles*, mainly focusing on the country-specific review of mangroves and their utilization and conservation over the past decades, (b) *case and comparative studies* which includes specific conservation experiences and shared learning from different conservation initiatives across major mangrove habitats, and (c) *scientific knowhow*, which states advances of current scientific knowledge about mangroves and their role in decision-making. The following paragraphs provide a brief overview of the chapters furnished in this book.

In Chaps. 2 and 3, Rahman et al. and Kathiresan provide a detailed overview of the history of mangrove degradation and current management strategies for mangrove conservation in Pakistan and India, respectively. These two overview articles are expected to provide comprehensive idea of mangrove conservation in the Indian subcontinent as well as detailed information of conservation challenges in the respective countries.

In Chap. 4, DasGupta and Shaw provide a case study from the Indian Sundarban mangroves and describe how the current participatory arrangement was introduced within the erstwhile protected areas. They further narrate the key sustainability issues of this combined management system which partly relies on preventive management and partly utilizes participatory conservation. In Chap. 5, Thamizoli describes another case study from India –where he specifically addresses the issues of community development through the Joint Mangrove Management Model. The author captures a successful case study of tribal empowerment through mangrove conservation and highlights how a participatory conservation model changed community profile in the study area.

Chapters 6, 7, 8, and 9 provide case studies from the Sundarban mangrove forests of Bangladesh – part of the largest single block mangrove forest in the

world. In Chap. 6, Sadath et al. narrate an empirical research work in order to map the stakeholders/actors through network analysis. This work, carried against the backdrop of a GIZ-funded mangrove restoration project in Bangladeshi Sundarban, provides specific intimations for project planning and execution for participatory mangrove conservation projects. In Chap. 7, Ali et al. argue the need for integrating livelihood in mangrove management against the backdrop of Sundarban. This chapter provides strong legal foundations for enhancing the effectiveness of forest management as well as to promote sustainable utilization of mangrove resources. On the other hand, Chap. 8 by Rahman et al., which is based on an empirical survey, assesses the potential of Bangladeshi Sundarban in terms of carbon sequestration and climate change adaptation. In Chap. 9, Ahsan et al. describe how resource dependency on mangroves changes during natural hazards and economic depressions through an empirical survey in Koyra subdistrict adjoining the Sundarban. This chapter leads to better understanding of the role of property rights for mangrove conservation.

In Chap. 10, Wickramasinghe describes a case study of Sri Lanka where mangroves are being currently restored through active involvements of local communities. The case study is drawn against the backdrop of Indian Ocean Tsunami in 2004 which made massive damage to the Sri Lankan mangroves.

In Chap. 11, Otsuyama et al. provide an overview of Ayeyarwady Delta mangrove with special emphasis on changing national policies, particularly the agricultural policies and their relationship with mangrove degradation in Myanmar. The chapter also identifies potential avenues for mangrove restoration in the country.

In Chap. 12, Nop et al. narrate the current opportunities and challenges of enhancing participatory mangrove conservation in Cambodia – one of the mangrove-rich yet less studied countries. On the other hand, in Chap. 13, Iwasaki and Teerakul narrate two case studies of participatory mangrove management from Thailand (Kuraburi Estuary and Songkhla Lake Basin) with a detailed narration of how state-controlled regime in Thailand resulted in mangrove degradation.

In Chap. 14, Iwasaki and Rahman provide an interesting case example from Aceh province of Indonesia. It documents the role of a traditional institution named as *Panglima Laot* in mangrove conservation. The chapter narrates how the perception of local fishers helped in mangrove regeneration in aftermath of the Indian Ocean tsunami in 2004. In Chap. 15, Dalimunthe and Perdana Putri provided another case example from Seribu Islands of Indonesia. The authors argue that despite of an attempt to promote community-based mangrove restoration through multi-stakeholder engagement, the current arrangement merely evolves as tokenism and lacks long-term sustainability. The case example is particularly imperative and highlights the need for midterm corrections of multi-stakeholder-based approaches of mangrove restoration.

In Chap. 16, Pulhin et al. narrate an overview of opportunities and challenges in community-based mangrove management in the Philippines. Policy amendments recommended in this chapter are useful for achieving long-term mangrove sustainability in the backdrop of the Philippines and beyond.

In Chap. 17, Ismail et al. describe in details the current management strategies of the Larut Matang mangroves in Malaysia which is considered among the best managed mangroves in the Asia-Pacific region. The chapter, with the help of secondary data, explores the efficiency and extent of community participation in the Matang mangrove reserve as well as advocate for sustainable utilization of mangrove resources for community development.

In Chap. 18, Khan and Kabir describe the ecology of biomass production and carbon trapping potentials of *Kandelia obovata*. The authors argue, based on their empirical study in Okinawa islands of Japan, that the species are suitable for new mangrove generation in the study area. This case study serves as an example of science-based decision-making for mangrove restoration.

In Chap. 19, Veitayaki et al. provide an important overview of mangroves in the Small Island Developing States (SIDS) in the Pacific Ocean. In the final conclusive chapter, i.e., the Chap. 20, the editors provide the summary of this book. Based on the furnished case studies in this book, this chapter draws the roadmap for participatory conservation of mangroves, by highlighting the commonalities and differences in conservation issues and existing challenges, and identifies the strategies to overcome these lacunas.

1.6 Expected Readership

The primary target groups for this book are students and researchers in the fields of conservation and management of mangroves and other natural resources, especially from the tropical developing countries of the Asia-Pacific region. We are also immensely hopeful that the book will positively contribute toward the ongoing mangrove restoration projects, being conducted by various government and nongovernmental organizations in the Asia-Pacific region. In particular, we hope that the collective knowledge from this book will help policy planners and practitioners to better understand the complex scenario of mangrove conservation, thereby enhancing their engagement toward proactive mangrove conservation and restoration.

Acknowledgment The editors would like to thank all the contributing authors for their contribution and meaningful insight and suggestion for this book.

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