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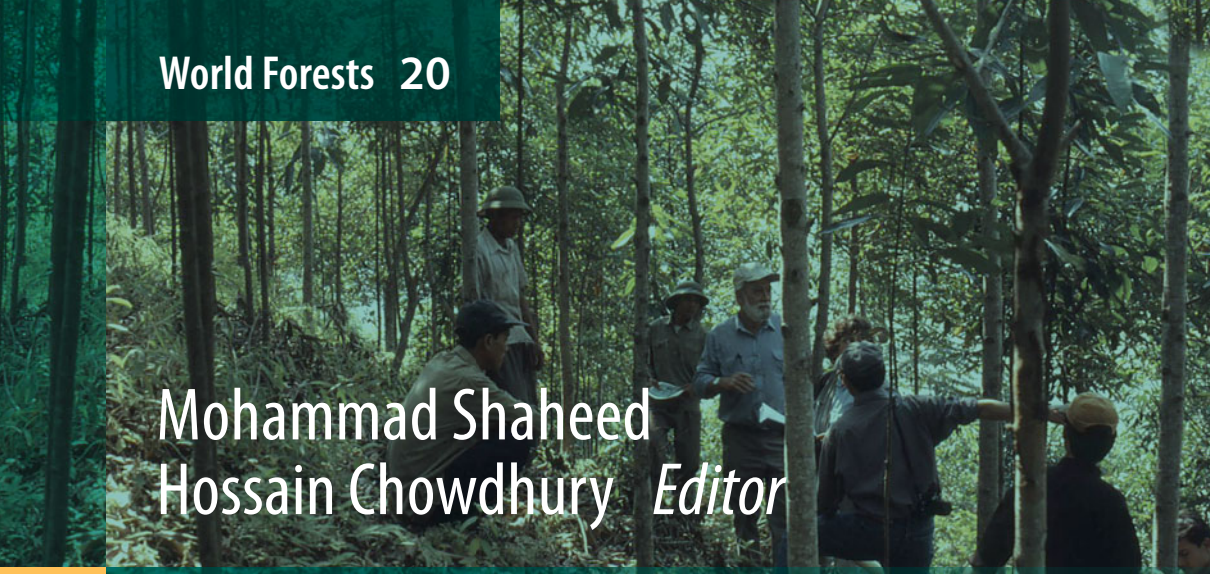

Mohammad Shaheed
Hossain Chowdhury *Editor*

Forest Conservation in Protected Areas of Bangladesh

Policy and Community Development Perspectives

Springer

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Volume 20

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Mohammad Shaheed Hossain Chowdhury
Editor

Forest Conservation in Protected Areas of Bangladesh

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ISSN 1566-0427 ISSN 1566-0427 (electronic)
ISBN 978-3-319-08146-5 ISBN 978-3-319-08147-2 (eBook)
DOI 10.1007/978-3-319-08147-2
Springer Cham Heidelberg New York Dordrecht London

Library of Congress Control Number: 2014944319

Printed on acid-free paper

Springer is part of Springer Science+Business Media (www.springer.com)

To the people who are dedicating themselves for nature conservation

Preface

Although for many years protected areas have proved to be important for conservation, because of the multifarious anthropogenic pressures, their implementation faces difficult challenges. The creation of many protected areas has led to the exclusion of local people who previously have had access to the resources therein. Conservation strategies commonly conflict with local livelihoods when local people are forced to use resources outside the conservation areas. Such incidence develops rivalry between protected area managers and local communities that ultimately results in ineffective implementation of the strategies and/or failure of the whole program of biodiversity conservation. Realizing the situation, local people's access to protected areas and incorporation of their needs in conservation efforts have been recognized worldwide by conservationists. Therefore, considering the logicality, the concept of collaborative management approach with the active participation of local communities has been developed. The Bangladesh government also adopted and implemented the concept in its protected areas, preliminarily in five forests as pilot projects. This book deals with a number of issues under the broad subject matter of protected area focusing on the policy of collaborative management as a means to augment forest conservation activities and enhance community development in some of these pilot sites.

The book is based on the findings of my Ph.D. research under the direct guidance and supervision of Prof. Masao Koike and Prof. Shigeyuki Izumiyama. With an overall goal of assessing the impact of co-management policy on rural community development, initially, the studies were conducted only in one protected area—Rema-Kalenga Wildlife Sanctuary—in order to examine the program activities precisely. Later, when the plan for book publication was made, studies from two other protected areas—Chunati Wildlife Sanctuary and Lawachara National Park—were included by inviting two prominent protected area researchers—A. Z. M. Manzoor Rashid and Sharif Ahmed Mukul. However, to be honest, the readers should not expect an attempt to condense everything known about protected area co-management in Bangladesh; this book is not written with an encyclopedic mindset. We just tried to present a critical examination of our current knowledge and ideas regarding protected area co-management, with a highlight on the areas of policy progress, community involvement, community livelihoods and improvement, governance evolvement, and prevailing threats and constraints.

The book begins with introducing Bangladesh, its forest settings, and protected area systems in Chap. 1 with a brief reference to protected area and collaborative management in the global context. Chapter 2 describes conceptual frameworks, research methods, and approaches that were followed both in the field and laboratory during data collection and data analysis, respectively. Chapter 3 deals with the evolutionary history of and periodical changes in the forest policy of Bangladesh, with highlights on the conservation aspects, the development of protected areas, and the gradual adoption of their collaborative management.

Chapters 4 and 5 articulate the major resource utilization by the local communities from protected areas in Bangladesh. Although local communities living in and around the forested regions of protected areas of Bangladesh traditionally extract various products from neighboring forests, here emphasis was given only on two products that are importantly involved with everyday life—fuelwood and medicinal plants. The huge rural populations that are further characterized as energy-poor, having no access to modern energy services, rely on biomass fuels, primarily fuelwood in Bangladesh for cooking everyday meals. Similarly, being poor and having less or no access to modern healthcare services, the rural people in Bangladesh heavily depend on medicinal plant-based traditional healthcare practices. These very basic needs, curbing the extraction that seems somewhat unethical in our opinion, are overlooked by many conservationists.

Chapter 6 evaluates the efficacy of co-management approach in community development. A significant level of development has occurred in the socioeconomic conditions of the community as an impact of this new management strategy of protected areas in Bangladesh. The provision of incentives significantly contributed to the increase in the community's annual income and a drastic change was observed in their primary occupation—agriculture/farming became the primary occupation for most of the people from that of day-laborer. Empowerment and improved social dignity of women participants signifies the initiation of co-management approach in protected area.

While protection of nature is the primary concern in protected areas, it is also recognized that meeting the needs and priorities of local communities is vital to guarantee the long-term survival of those areas. To define and identify the problems properly in local context, there is no substitute for ensuring the accurate participation of the local stakeholders. Chapter 7 deals with the assessment of the local stakeholders' participation level in and attitudes toward co-management program.

Chapter 8 deals with exploring the potential of traditional agroforestry systems of three ethnic communities in conserving biological diversity in and around Lawachara National Park, while Chap. 9 deals with the assessment of the role of co-management organizations on protected area governance in Chunati Wildlife Sanctuary. There are repeated arguments by conservation biologists that the application of wildlife-friendly farming methods could potentially reduce the impact of agriculture on biodiversity. In such contexts, examining the potential of traditional agroforestry systems is a highly time-demanding issue, especially when

such systems may act as refuges for many species in a society suffering from poverty, unemployment, and high population density.

Chapter 10 presents a critical review of the state of protected area co-management in the global context. An attempt was made to correlate it with that of Bangladesh by presenting the results of a case study of local people's views about the co-management impacts on wildlife status in a Bangladeshi protected area. While co-management has both success and failure stories in different parts of the world, it came out with a story of success in Bangladesh, in terms of community development, and in terms of biodiversity conservation.

Chapter 11 deals with the exploration of potential threats to protected areas and constraints of conservation efforts in Bangladesh. Although protected area-based biodiversity conservation efforts through co-management programs show upbeat impacts in Bangladesh, the protected areas are still subject to a range of threats, making the country's biodiversity conservation programs fragile. Most of the threats are anthropogenic and should be taken into thoughtful consideration by the authority.

The book concludes with the presentation of a general metaphysical model, namely 'Spider-web model of protected area co-management' in Chap. 12 that has been developed based on lessons from the studies discussed in other chapters. The conclusion was made with an inference that the model can be potentially applicable in countries where local communities rely heavily on protected areas.

Mohammad Shaheed Hossain Chowdhury

Acknowledgments

It is not always easy to acknowledge the debts that the editor accumulates during the period of preparing this book. I wish to express my heartfelt gratitude to Prof. Dr. Masao Koike for his close supervision, continuous guidance, and commenting on the works conducted as the requirements for writing my Ph.D. thesis, in which the seed of this book was sowed. My intense gratefulness to Dr. Md. Danesh Miah (Institute of Forestry and Environmental Sciences, Chittagong University, Bangladesh), who induced my interest on scientific research since my undergraduate level, with the nurturing of which I dared to dream of pursuing Ph.D. research. My heartfelt gratitude is to Dr. Nur Muhammed (School of International Tropical Forestry, University Malaysia Sabah), who showed me the new door to open in Shinshu University for fulfilling my long-cherished dream.

I am thankful to Bangladesh Forest Department for its cooperation and logistic support during the field works and community survey. I am indebted to Md. Abdul Halim, Abu Syed Arfin Khan, Md. Mostafizur Rahman, Sharif Ahmed Mukul, Dr. A. Z. M. Manzoor Rashid, Dr. Niaz Ahmed Khan, and Md. Parvez Rana for their sincere assistance in the time of data collection and manuscript preparation. I am very grateful to Dr. Michael S. Philip (ex-Editor of Forests, Trees and Livelihoods), Dr. Steve Harrison (The University of Queensland, Australia), Laura Applegate (Washington State University, USA), Bronwen Powell (McGill University, Canada), Sue Stolton (Editor of PARKS Journal) for their valuable suggestions at various stages of the manuscript preparation.

I humbly acknowledge the concerned authorities of the Ministry of Education, Culture, Sports, Science and Technology, Japan, the Japan Society for the Promotion of Science (JSPS) and Shinshu University, Japan for granting me *Monbukagakusho*: MEXT scholarship for Ph.D. research, Post-Doctoral Fellowship and necessary assistance, respectively.

During my stay in Japan far from my homeland, a lot of remarkable individuals have given meaning to my life, opened their hearts and doors to me, supported and believed in me and all my undertakings. Without their presence in my life, it wouldn't have been possible to accomplish writing the thesis smoothly: my enormous gratefulness is to the benevolent members of Ina English Guide Club, Nagano-Ken, Japan.

My immense gratitude to my family: my mother, Mrs. Jahanara Begum, for her tireless work to bring me here, for her love and advice since the very childhood and for her rigid, supportive voice over telephone during the exhausting time of my overseas stay; my late father Mr. Mohammad Abdul Hai, for his unconscious initiating of love for nature in me; my wife, Dr. Shameema Islam Rimi, for her friendship and intelligence, for our common dreams and unremitting strength to carry on and enjoy every moment of our lives, and for all cheerful talks and sweet smiles during my tough times burdened with workloads; my father-in-law, Md. Serajul Islam, for his generous supports; my brothers and sisters for providing all sorts of good wishes to me always; and my loving little son Ahmed Nawaaf Zayn (Shusnato), whose innocent face and divine smile relinquish all my stress and agony due to the eventful everyday academic hours. I am indebted to all my friends, whose ever-encouraging comments are always with me.

Mohammad Shaheed Hossain Chowdhury

Contents

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Shigeyuki Izumiyama, wildlife ecologist, is a professor in the Institute of Mountain Science of Shinshu University, Japan. He has many years' experience of teaching and research on wildlife behavior, wildlife habitat ecology, and human-wildlife conflicts. Currently, he is working on wildlife ecology in Japan, Kyrgyzstan, Russia, and Bangladesh.

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Chapter 1
Introduction

Mohammad Shaheed Hossain Chowdhury, Masao Koike and Shigeyuki Izumiyama

1.1 Geographical Location of Bangladesh

Bangladesh is situated in the southern part of Asia (Fig. 1.1) and lies between 20°34′ and 26°38′ North longitudes and 88°01′ and 92°41′ East latitudes. The country has an area of 147,570 km^2 and extends 820 km north to south and 600 km east to west. Bangladesh is bordered on the west, north, and east by a 2,400-km land frontier with India and, in the southeast, by a short land and water frontier (193 km) with Myanmar. On the south is a highly irregular deltaic coastline of about 580 km, fissured by many rivers and streams flowing into the Bay of Bengal. The territorial waters of Bangladesh extend 12 nautical miles (22 km), and the exclusive economic zone of the country is 200 nautical miles (370 km) (Government of Bangladesh (GoB) 2010).

The terrain of Bangladesh is mostly flat alluvial plain, but it is hilly in southeast. The only exceptions to Bangladesh's low elevations are the Chittagong Hills in the southeast, the Low Hills of Sylhet in the northeast, and highlands in the north and northwest. The Chittagong Hills constitute the only significant hill system in the country and, in effect, are the western fringe of the north-south mountain ranges of Myanmar and eastern India. The Chittagong Hills rise steeply to narrow ridge lines, generally no wider than 36 m. Fertile valleys lay between the hill lines, which generally run north-south. West of the Chittagong Hills is a

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M. S. H. Chowdhury (ed.), *Forest Conservation in Protected Areas of Bangladesh*, World Forests 20, DOI: 10.1007/978-3-319-08147-2_1,

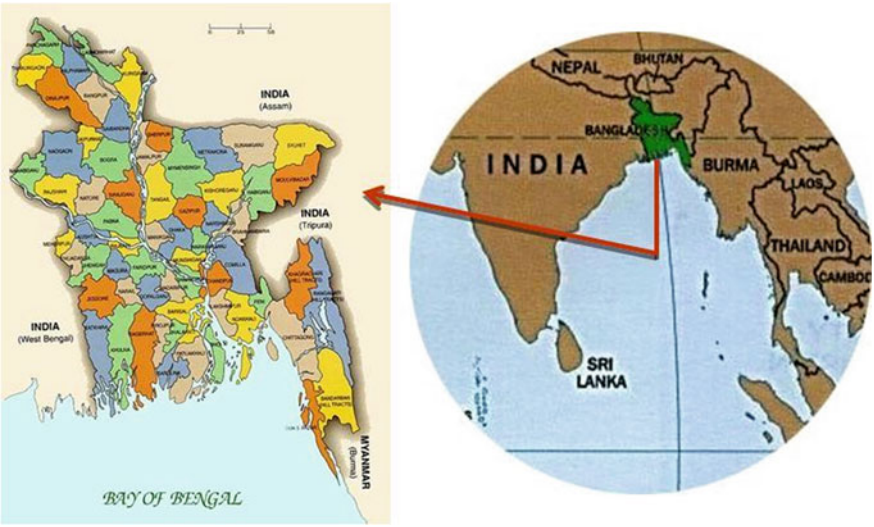

Fig. 1.1 Map of Bangladesh with its location in Asian region

broad plain, cut by rivers draining into the Bay of Bengal that rises to a final chain of low coastal hills, mostly below 200 m, that attain a maximum elevation of 350 m. West of these hills is a narrow, wet coastal plain located between the cities of Chittagong in the north and Cox's Bazar in the south. The lowest point in the country is Indian Ocean (0 m) while the highest point is Tajindong (1,280 m) (GoB 2010).

1.2 Socio-economic Features

Recent (2007–2010) estimates of Bangladesh's population range from 150 to 164 million and it is the 7th most populous nation in the world. The overwhelming majority of Bangladesh population is ethnic *Bangalee*s, comprising 98 % of the population. The remainders are mostly the members of few small ethnic groups. The main religion practiced in Bangladesh is Islam (89.7 %), but a significant minority adheres to Hinduism (9.2 %) while the remainders (1.1 %) are of Buddhism and Christianity. The literacy rate is 53.5 % and is increasing gradually (United Nations Development Program (UNDP) 2009). Bangladesh is a developing economy; since 1996 the economy has developed at a pace of 5–6 % per year. Its per capita income rises to US$690 in 2008–2009 fiscal years which was US$608 in 2007–2008 fiscal years (Bangladesh Budget Watch 2009). Although two-thirds of the total populations are farmers, more than three quarters of Bangladesh's export earnings come from the garment industry. The society is of agrarian characteristics where about 74.5 % people live in rural areas (Food and

Agriculture Organization (FAO) 2010). About 67 % of Bangladesh's nonurban land is arable. Permanent crops cover only 2 %, meadows and pastures cover 4 %, and forests and woodland cover about 17 %. According to World Bank (2010), the growth of GDP in Bangladesh is 6.2 %.

1.3 Physical Features

1.3.1 Climatological Facts

Bangladesh has a subtropical monsoon climate characterized by wide seasonal variations in rainfall, moderately warm temperatures, and high humidity. Regional climatic differences in this flat country are minor. Three seasons are generally recognized: a hot, humid summer from March to June; a cool, rainy monsoon season from June to October; and a cool, dry winter from October to March. In general, maximum summer temperatures range between 32 and 38 °C. April is the warmest month in most parts of the country. January is the coldest month, when the average temperature for most of the country is 10 °C (Discovery Bangladesh 2010).

Heavy rainfall is characteristic of Bangladesh. With the exception of the relatively dry western region of Rajshahi, where the annual rainfall is about 160 cm, most parts of the country receive at least 200 cm of rainfall per year. Because of its location just south of the foothills of the Himalayas, where monsoon winds turn west and northwest, the region of Sylhet in northeastern Bangladesh receives the greatest average precipitation (Discovery Bangladesh 2010).

1.3.2 The River System

About 700 in number, the rivers generally flow south. The profusion of rivers can be divided into five major networks. The Jamuna-Brahmaputra is 292 km long and extends from northern Bangladesh to its confluence with the Padma. Originating as the Yarlung Zangbo Jiang in China's Xizang Autonomous Region (Tibet) and flowing through India's state of Arunachal Pradesh, where it becomes known as the Brahmaputra ("Son of Brahma"), it receives waters from five major tributaries that total some 740 km in length. At the point where the Brahmaputra meets the Tista River in Bangladesh, it becomes known as the Jamuna.

The second system is the Padma-Ganges, which is divided into two sections: a 258-km segment, the Ganges, which extends from the western border with India to its confluence with the Jamuna some 72 km west of Dhaka, and a 126-km segment, the Padma, which runs from the Ganges-Jamuna confluence to where it joins the Meghna River at Chandpur. The Padma-Ganges is the central part of a deltaic

river system with hundreds of rivers and streams—some 2,100 km in length—flowing generally east or west into the Padma.

The third network is the Surma-Meghna River System, which courses from the northeastern border with India to Chandpur, where it joins the Padma. The Surma-Meghna, at 669 km by itself the longest river in Bangladesh, is formed by the union of six lesser rivers. Below the city of Kalipur it is known as the Meghna. When the Padma and Meghna join together, they form the fourth river system—the Padma-Meghna—which flows 145 km to the Bay of Bengal.

This mighty network of four river systems flowing through the Bangladesh Plain drains an area of some 1.5 million km^2. The numerous channels of the Padma-Meghna, its distributaries, and smaller parallel rivers that flow into the Bay of Bengal are referred to as the Mouths of the Ganges. Like the Jamuna, the Padma-Meghna and other estuaries on the Bay of Bengal are also known for their many chars.

A fifth river system, unconnected to the other four, is the Karnaphuli. Flowing through the region of Chittagong and the Chittagong Hills, it cuts across the hills and runs rapidly downhill to the west and southwest and then to the sea. The Feni, Karnaphuli, Sangu, and Matamuhari—an aggregate of some 420 km—are the main rivers in the region (Banglapedia 2009).

1.4 Forestry Scenario of Bangladesh

Forestry is a productive sector with significant effects on meeting national socio-economic and environmental functions as well as the improvement of rural livelihoods (Mbuvi and Boon 2008). Increasing pressure on forest resources from multiple sectors exerts significant challenges to forest and environmental managers worldwide who must strike a balance between demand and the need to protect these important renewable resources (Muhammed et al. 2008a). In correspondence with this prevailing situation, Matthews (2001) informed that deforestation rates have been increased in tropical Africa, remained constant in Central America and declined only slightly in tropical Asia and South America. It is, in fact, difficult to have reliable data on the actual rate of tropical forest resources and deforestation because of the different methods of forest resources assessment in tropical countries and the lack of uniform and generally accepted definitions (Goldsmith 1998). However, Appiah et al. (2008) explored the combined effect of several causes responsible for the shrinking of most of the accessible tropical forests, e.g., forest fires, logging, agricultural colonization, mining activities, wild land fires, and other development projects. Bangladesh, formed by a delta plain at the confluence of three big rivers—the Padma, the Meghna, the Jamuna—and their tributaries, possesses a tropical monsoon climate and harbors a huge biological diversity. But, with a total land area of only 147,570 km^2 and high population density (1,079 people/km^2), a tremendous pressure has been exerting on its limited resources which also affects the forest reserves both in explicit and implicit ways

(Food and Agriculture Organization (FAO) 2007). Muhammed et al. (2008a) mentioned that forests in Bangladesh are deteriorating at an alarming rate due to various socio-economic threats, biotic pressures and competing land uses. The high degree of dependency that many people have on the forests for their livelihoods has resulted in depletion of natural resources and degradation of forest ecosystems countrywide (Muhammed et al. 2008b). The total growing stock of Bangladesh forests is 30 million m^3 and the total biomass 63 million tons (FAO 2007). FAO (2007) assessed the annual rate of negative change of forests by 2,000 ha per year or 0.3 % in 2000–2005 in Bangladesh. At an annual population growth rate of 1.7 %, such deforestation is likely to continue and forests are likely to disappear by next 35–40 years or earlier (Nishorgo 2008). Realizing such threats, Bangladesh government has explored and implemented some alternative forest management strategies for the conservation purposes (Rana et al. 2007); forests or part of forests have been declared as protected areas according to the IUCN categories.

1.4.1 Forests Setting of Bangladesh

The total area of forestland of Bangladesh is 2.52 million ha of which the Forest Department (hereafter FD) manages 1.52 million ha (Table 1.1). The other 0.73 million ha designated as Unclassed State Forest (USF) are under the control of Ministry of Land and the remaining 0.27 million ha fall under the category of village forests that are under private ownership (BFD 2008). However, contradiction exists on the actual coverage of the forests (Mukul et al. 2008). Forest Resources Assessment 2005 (FAO 2007) shows the total area of forest is 0.87 million ha (some 6.7 % of the country's total area). This includes only the designated government reserved and protected forests excluding the USF, plantations, village forests and other private forests (Muhammed et al. 2005).

The tropical evergreen and semi-evergreen forests (commonly known as hill forests) of Bangladesh occur in hilly areas of the northeastern and southeastern region, tropical moist deciduous forests (commonly known as Sal forests) are distributed in the central and a little part of northwestern region, the mangrove forest (commonly known as Sundarban) lie in the southwestern portion facing the Bay of Bengal, and the freshwater swamp forest (commonly known as reed-land forest) is located in the low-lying wetland areas of northeastern region of the country. According to recent estimate, the total growing stock of Bangladesh's forests is 30 million m^3 and the total biomass 63 million tons (FAO 2007), which contributes to wellbeing of the countrymen both in tangible and intangible ways such as by maintaining the quality of local and national environment, adding input in GDP, and providing livelihoods to local communities (Iftekhar 2006). The village forests or village groves in the country are the homesteads and are entirely private properties (Khan et al. 2007). These traditional homesteads are the dominating feature in the rural landscape of Bangladesh (Iftekhar 2006), forming the

Table 1.1 Total forestlands of Bangladesh (BFD 2008)

Category	Area (million ha)	Percentage of total land
Forest Department (FD) managed forests		
Hill forests	0.67	4.54
Natural mangrove forests	0.60	4.07
Mangrove plantations	0.13	0.88
Plain land Sal forest	0.12	0.81
Total	1.52	10.30
Unclassed State Forest (USF)	0.73	4.95
Village forest	0.27	1.83
Grand total	2.52	17.08

most productive tree resources of the country (BFD 2008). Vergara (1997) revealed that about 70 % of fuel wood and timber and 90 % of bamboos used in construction and cottage industries come from homesteads whilst Mustafa et al. (2002) reported about 55 % of the national requirement of timber, fuel wood, and bamboo are met from those informal forests.

1.4.2 The Forest Types

Based on broad characteristics of physiognomy (general appearance) and structure (floristic composition), the forests of Bangladesh have been classified into four ecological categories (Das 1990). The major forest types include (i) tropical wet evergreen and semi-evergreen forests, (ii) tropical moist deciduous forests, (iii) tropical littoral and mangrove forests and (iv) fresh water swamp forests.

1.4.2.1 Tropical Wet Evergreen and Semi-evergreen Forests

These forests occur in the hilly areas of the northeastern and southeastern region of the country covering the districts like Chittagong, Chittagong Hill Tracts, Cox's Bazar and Sylhet. The major species are Champa (*Michelia champaca*), Chapalish (*Artocarpus chaplasha*), Chickrassi (*Chickrassia velutina*), Civit (*Swintonia floribunda*), Garjan (*Dipterocarpus* spp.), Telsur (*Hopea odorata*), Dhakijam (*Syzygium grande*), Mangium (*Acacia mangium*), Mehogony (*Swietenia* spp.), Lohakat (*Xylia dolabriformis*), Bailam (*Anisopera scaphula*), Gamar (*Gmelina arborea*), Koroi (*Albizia* spp.), Toon (*Toona ciliata*), Arjun (*Terminalia arjuna*), Bandarhola (*Duabanga grandiflora*), Jarul (*Lagerstroemia speciosa*), Kadam (*Anthocephalus chinensis*), Kainjal (*Bischofia javanica*), Pitali (*Trewia nudiflora*), Shimul (*Bombax ceiba*), Kamdeb (*Calophyllum polyanthum*), Uriam (*Mangifera sylvatica*), Tali (*Dichopsis polyantha*), Jhau (*Casuarina equisetifolia*), Khair

(*Acacia catechu*), Minjiri (*Cassia siamea*), Sissoo (*Dalbergia sissoo*) and others are found in the Hill forests. Besides, bamboo, cane, climber, fern are also found there. Some of the common bamboo species are: Bariala (*Bambusa valgaris*), Basali (*Teinostavhayum griffithi*), Daloo (*Neohuzeaua dullooa*), Kali (*Oxytenanthera nigrociliata*), Kaiera (*Oxytenanthera auriculata*), Mitenga (*Bambusa tulda*), Muli (*Melocana baccifera*) and Orah (*Dendrocalamus longispathus*).

This forest region is also rich in faunal diversity. Important mammals include Elephant (*Elephas maximus*), Rhesus Macaque (*Macaca mulatta*), Wild Pig (*Sus scrofa*), Barking deer (*Muntiacus muntjak*), Sambhar (*Cervus unicolor*) and Indian Leopard (*Panthera pardus*). Of the reptiles, King Cobra (*Ophiophagus hannah*), Monitor Lizard (*Calotes versicolor*) and Bengal Monitor Lizard (*Varanus bengalensis*) are common.

1.4.2.2 Tropical Moist Deciduous Forests

These forests, commonly known as Sal (*Shorea robusta*) forests are distributed over the central part and some areas of the northern part of the country. These forests are scattered in nature and intricately mixed with habitations. The dominant tree species found in the Sal forests is Sal (*Shorea robusta*). Other species include Banyan (*Ficus bengalensis*), Ashwath (*Ficus religiosa*), Koroi (*Albizia* spp.), Ajuli (*Dillenia pentagyna)*, Sonalu (*Cassia fistula*), Bohera (*Terminalia balarica*), Haritaki (*Terminalia chebula*), Kanchan (*Bauhinia acuminata*), Jarul (*Lagerstroemia speciosa*), Kurchi (*Holarrhena antidysenterica*), Jam (*Syzygium* spp.) etc.

Important mammals include Jackal (*Canis auveus*), Bengal Fox (*Vulpes bengalensis*), Rhesus Macaque (*Macaca mulatta*), Jungle Cat (*Felis chaus*). Of the reptiles, Bengal Monitor Lizard (*Varanus bengalensis*) and Common Cobra (*Naja naja*) are important. A total of 220 species of wildlife including 12 amphibians, 25 reptiles, 148 birds and 35 mammal species are available in the Sal forests.

1.4.2.3 Tropical Littoral and Mangrove Forests

The natural mangroves include the Sundarbans and Chokoria Sundarbans. The Sundarbans is the unique largest continuous productive mangrove forest of the world, spreading over the southwestern part of Bangladesh and west Bengal State of India. About 62 % of the Sundarbans are in Khulna District of Bangladesh, and the remaining 38 % is in the 24-Parganas District of West Bengal. There are 25 true mangrove species in the Sundarbans. Of the entire tree species, Sundri (*Heritiera fomes*) is the most important one, which occupies 73 % of Sundarbans. Sundri is followed by Gewa (*Excoecaria agallocha*), Baen (*Avicennia officinalis*), Passur (*Xylocarpus mekongensis*) and Keora (*Sonneratia apetala*). There are numerous minor forest products such as Golpata (*Nypa fruticans*), honey, bee's wax, fish and others.

The Sundarbans is also famous for some of the important animal species. Important mammals include Royal Bengal Tiger (*Panthera tigris tigris*), Gangetic Dolphin (*Platanista gangetica*), Rhesus Macaque (*Macaca mulatta*), Indian Fishing Cat (*Felis viverrina*), Indian Otter (*Lutra prespicillata*) and Spotted Deer (*Axis axis*). Of the reptiles, Estuarine Crocodile (*Crocodilus porosus*), Monitor Lizard (*Varanus salvator*), Rock *Python* (*Python molurus*) and Green Turtle (*Cheoria mydas*) are important.

1.4.2.4 Fresh Water Swamp Forests

These forests, also known as reed-land forests are situated in the low-lying areas of Sylhet Division of Bangladesh. Reed land areas are distributed in three ranges under five upazillas (sub-districts) namely Chattak and Dowarabazar of Sunamganj District and Gowainghat, Companigonj and Jaintapur of Sylhet District. The reed lands are dominated by the reed swamp association known as Pajuban and consist of tall grasses mainly Nal (*Phragmites kakra*), Khagra (*Saccharum spontaneum*), and Ekra (*Eranthus ravannae*). Meadow grasses such as Binna (*Vetivera zizaniodes*) dominate the open areas. Woody shrubs such as Shatamuli (*Asparagus racemosus*), Chitki (*Phyllanthus disticha*), and Baladumur (*Ficus heteriphylla*) occur with the tree vegetation sporadically found in higher ground and are generally of the scattered tree type. Murta (*Schumannianthus dichotoma*) grows abundantly in patches all over the reed lands. The main tree species include Hijal (*Barringhtonia acutangula*), Karach (*Pongamia pinnata*), Barun (*Crataeva nurvata*), and Bhuri/Pitali (*Trewia nudiflora*). The reed land areas are also very rich in faunal diversity. A survey reported 27 mammals, 49 birds, 22 reptiles and nine amphibians from the reed-land forests (Khan et al. 2007).

1.4.3 State of Biodiversity

Bangladesh vegetation is a transition of Indo-Malayan region, which is one of the ten global hot-spot areas for biodiversity (Mittermeier et al. 1998). The hill forests are characterized as mixed evergreen forests where tropical evergreen plant communities are mixed with tropical deciduous trees, in association with diverse herbs, shrubs, and bamboo jungles. In Sal forest, 70–75 % of the trees are Sal (*Shorea robusta*) associated with other semi-evergreen and deciduous plants (BCAS 2008). The Sundarban, the largest single tract of mangrove forest in the world (Iftekhar 2006) has a unique combination of terrestrial and aquatic ecosystem and is the home to several uniquely adapted floras with a total of 334 species including 13 orchids and 23 medicinal plants (BCAS 2008).

The country is also rich in faunal diversity by housing 110 inland and three marine mammals, 109 inland and 17 marine reptiles, 22 amphibians, 388 resident and 240 migratory birds, 266 freshwater and 442 marine fish, four freshwater and

Table 1.2 Number and status of vertebrate species of Bangladesh (IUCN 2000)

Group	Total no. of existing species	Extinct species	Threatened species			
			Critically endangered	Endangered	Vulnerable	Total
Inland mammals	110	10	21	13	6	40
Inland reptiles	109	1	12	24	22	58
Inland amphibians	22	0	0	3	5	8
Resident birds	388	2	19	18	4	41
Total	629	13	52	48	38	147

11 marine crabs, 2,493 insects and 66 species of corals (The World Conservation Union (IUCN) 2000) (Table 1.2). According to BCAS (2008), singly the Sundarbans supports 42 species of mammals, 35 reptiles, eight amphibians, 270 birds, seven crabs, 400 fish and 77 species of insects and the reed-land forest bears 27 mammals, 22 reptiles, nine amphibians and 49 birds.

But the biodiversity of Bangladesh is subject to depletion due to various kinds of human induced interventions and activities. Many of the plants and animals have either vanished or have been on their way to waning because of habitat loss (Iftekhar 2006; Muhammed et al. 2005). Bangladesh National Herbarium already identified 106 vascular plant species under risk of various degrees of extinction in the country (Khan et al. 2001). On the other hand, Islam (2004) reported that 95 vascular plants have been rated as threatened, of which 92 are angiosperms and three gymnosperms. Regarding the fauna, Rahman (2004) reported about 12 wildlife species are extinct from the country and IUCN (2000) in its Red Data Book, listed a total of 40 mammals, 58 reptiles, eight amphibians, and 41 resident bird species as threatened (Table 1.2). Therefore, it seems that the state of Bangladesh's biodiversity has been worsening day by day.

1.5 Protected Area, Local Livelihoods and Community Involvement: National and International Perspective

1.5.1 'Protected Area (PA)' Definition

Through its Commission on National Parks and Protected Areas (CNPPA) (presently World Commission on Protected Areas (WCPA)), IUCN has given the definition of protected areas at the IV World Congress on National Parks and Protected Areas in Caracas, Venezuela in February 1992 as "*an area of land and/or sea especially dedicated to the protection and maintenance of biological diversity, and of natural and associated cultural resources, and managed through*

legal or other effective means" (The World Conservation Union (IUCN) 1994). Subsequently, IUCN members have worked together to produce a revised definition of a PA as ***"a clearly defined geographical space, recognized, dedicated and managed, through legal or other effective means, to achieve the long-term conservation of nature with associated ecosystem services and cultural values"***. The first draft of this new definition was prepared at a WCPA meeting in Almeria, Spain in May 2007 and since then has been successively refined and revised by many people within IUCN-WCPA (Dudley 2008).

1.5.2 The IUCN Categories of Protected Area

As protected areas in the modern sense were set up in one country after another during the twentieth century, each nation developed its own approach to their management and there were initially no common standards or terminology. One result is that many different terms are used at the national level to describe PAs and there are also a variety of international protected area systems created under global conventions (e.g., World Heritage sites) and regional agreements (e.g., Natura 2000 sites in Europe). Therefore, IUCN, at the IV World Congress on National Parks and Protected Areas has given international guidance on the categorization of protected areas. A total of six different categories were developed (Thomas and Middleton 2003; Dudley 2008) (Table 1.3) with the objectives of conserving the composition, structure, function and evolutionary potential of biodiversity; contributing to regional conservation strategies (as core reserves, buffer zones, corridors, steppingstones for migratory species etc.); maintaining the diversity of landscape or habitat and of associated species and ecosystems; being of sufficient size to ensure the integrity and long-term maintenance of the specified conservation targets or be capable of being increased to achieve this end; maintaining the values for which it was assigned in perpetuity; being operating under the guidance of a management plan, and a monitoring and evaluation program that supports adaptive management; and possessing a clear and equitable governance system (Dudley 2008).

1.5.3 Protected Areas and Community Livelihoods

Local people have been exercising their traditional rights over the resources of PAs since ancient times. It has been a perpetual narrative for protection of various potential areas for nature or recreational purposes to exclude humans and other species (Adams and Hulme 2001) and generally exclude local people who previously and hitherto have had access to the resources (Holmern 2003). Population growth in the last remaining wilderness areas is booming at twice the world's average hence exerts more pressures on those areas. This is basically from the

Table 1.3 IUCN categories of protected areas

Category		Denoting terms	Purpose of management	Specific definition
I	I(a)	Strict Nature reserves	For science promotion or wilderness protection	These are strictly protected areas set aside to protect biodiversity and also possibly geological/ geomorphological features, where human visitation, use and impacts are strictly controlled and limited to ensure protection of the conservation values. Such protected areas can serve as indispensable reference areas for scientific research and monitoring
	I(b)	Wilderness areas	For science promotion or wilderness protection	These are usually large unmodified or slightly modified areas, retaining their natural character and influence, without permanent or significant human habitation, which are protected and managed so as to preserve their natural condition
II		National parks	For ecosystem protection and recreation	These are large natural or near natural areas set aside to protect large-scale ecological processes, along with the complement of species and ecosystems characteristic of the area, which also provide a foundation for environmentally and culturally compatible spiritual, scientific, educational, recreational and visitor opportunities
III		Natural monuments or features	For conservation of specific natural features	The areas set aside to protect a specific natural monument, which can be a landform, sea mount, submarine cavern, and geological feature such as a cave or even a living feature such as an ancient grove. They are generally quite small protected areas and often have high visitor value
IV		Habitat/species management areas	For conservation through management intervention	The areas aim to protect particular species or habitats and management reflects this priority. Many category IV protected areas will need regular, active interventions to address the requirements of particular species or to maintain habitats, but this is not a requirement of the category

(continued)

Table 1.3 (continued)

Category	Denoting terms	Purpose of management	Specific definition
V	Protected landscape or seascapes	For landscape/ seascape conservation and recreation	An area where the interaction of people and nature over time has produced an area of distinct character with significant ecological, biological, cultural and scenic value: and where safeguarding the integrity of this interaction is vital to protecting and sustaining the area and its associated nature conservation and other values
VI	Protected areas with sustainable use of natural resources	For the sustainable use of natural ecosystems	These areas conserve ecosystems and habitats, together with associated cultural values and traditional natural resource management systems. They are generally large, with most of the area in a natural condition, where a proportion is under sustainable natural resource management and where low-level non-industrial use of natural resources compatible with nature conservation is seen as one of the main aims of the area

communities' dependence upon conservation areas for their livelihoods. For instance, in Africa alone, 600 million people have been estimated to rely on forests and woodlands including the conservation areas for their livelihoods (Anderson et al. 2006). Eighty-one village communities depend on the Nam Et-Phou Loei area in Lao for non-timber forest products (NTFPs), the value of which is estimated at US$1.88 million/year (International Center for Environmental Management (ICEM) 2003). Regarding drinking water, 33 of the world's 105 largest cities obtain a significant proportion of their drinking water from PAs (Secretariat of the Convention on Biological Diversity (SCBD) 2008). More specifically, around 85 % in San Francisco's drinking water comes from Yosemite National Park (Natural Resources Defense Council (NRDC) 2003), 80 % of Quito's 1.5 million population use drinking water originating from the Antisana PA and the Cayambe-Coca Ecological Reserve (Pagiola et al. 2002) and the water sources for Rio de Janeiro are protected by 14 PAs and the Atlantic Rainforest Biosphere Reserve in Brazil (Sericchio 2003). Therefore, inhibiting local people's access to PAs can be impractical, unaffordable, and ethically questionable (Buck et al. 2007).

Very commonly, the conservation strategies cause local livelihoods to conflict with conservation since local people are forced to use resources outside the conservation areas (Salafsky and Wollenberg 2000). Among the six IUCN categories

of PAs, four do not allow consumptive use of the resources by strictly defining borders that unauthorized people are not supposed even to cross (Wapalila 2008). Although PAs are proven to be important for conservation, the concept faces difficult challenges and dilemma interrelated with rural development and biodiversity conservation (Holmern 2003). The benefits of PAs for local communities can include direct revenue from environmental protection, livelihood diversification, security of access to given resources and the maintenance of ecosystem services such as watershed protection (Campbell et al. 2008). Costs can range from significant crop damage by wildlife (e.g., Bajracharya et al. 2006) to displacement of local communities from their customary lands (West et al. 2006). The nature of these costs and benefits depends largely upon the protected area's status and governance, as well as its history of use. Some PAs restrict access to resources, whereas others allow sustainable use; and land tenure arrangements and benefit sharing vary across the six IUCN management categories (Campbell et al. 2008). Campbell and colleagues also explored the varied livelihood impacts with PA status, management strategies and community involvement in governance. Management structures can provide direct benefits, for example through employment, but can restrict access to resources, alter local power structures, and change social/traditional values and behaviors. Strictly PAs with top-down management structures can result in major livelihood costs, generating conflict with local communities. In contrast, community management schemes, and PA management allowing sustainable use of forest resources have been shown to provide tangible livelihoods benefits.

1.5.4 Collaborative Management of Protected Areas

Experience has shown that legal protection alone is not enough to ensure effective conservation activity. A possible alternative is multiple use forest management, which incorporates harvesting of forest products within a framework of sustainable management that aims at both conserving biodiversity and supplying to local people and the national economy (Dupuy et al. 1999). And this can be guaranteed if effective relationships between the conservation areas and local communities are maintained (Schelhas et al. 2002). With the increasing use of social science tools such as social impact assessment (SIA), participatory rural appraisal (PRA) and action research, the relationship between people and PAs has been evolved into a management partnership, termed as collaborative management, involving all the major stakeholders (Oli 1999). Collaborative management or Co-management approach has evolved through various iterations and the way they are implemented on the ground varies (Arnold and Bird 1999). This is an approach where "two or more social actors negotiate, define and guarantee amongst themselves a fair sharing of management functions, benefits, mandates, and responsibilities for a certain area or a set of natural resources" (Borrini-Feyerabend et al. 2004). The idea is that an agency with jurisdiction over an area (usually a state agency) might develop 'a

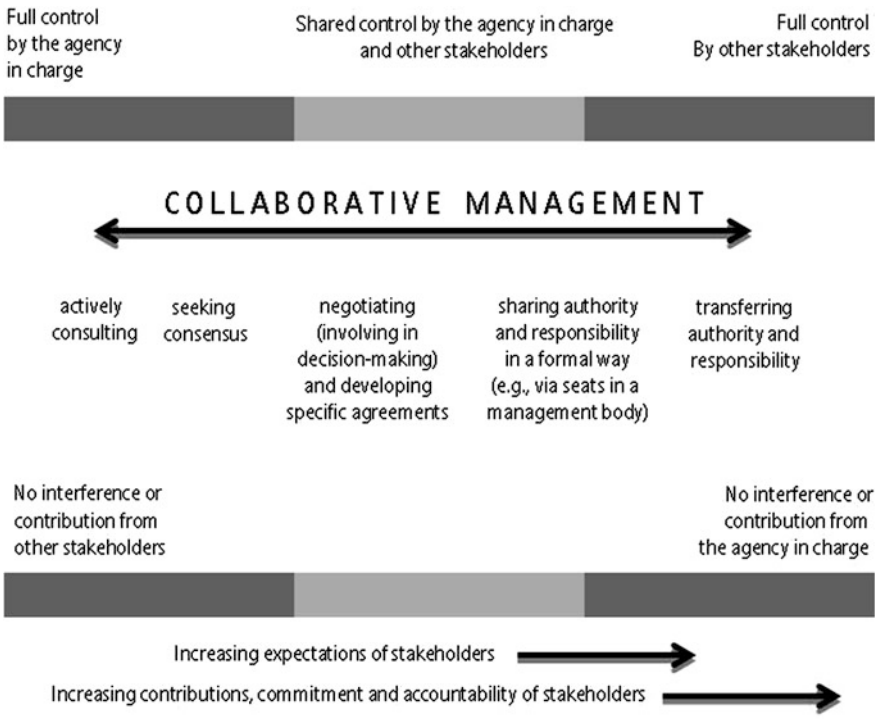

Fig. 1.2 Stakeholder participation in PA management—a continuum (adapted from Borrini-Feyerabend 1996)

partnership with other relevant stakeholders (primarily including local residents and resource users) which specifies and guarantees their respective functions, rights and responsibilities with regard to the (area)' (Borrini-Feyerabend 1996). Sometimes referred to as joint management, co-management involves "institutional arrangements whereby governments and aboriginal (and sometimes other parties) enter into formal agreements specifying their respective rights, powers and obligations with reference to the management and allocation of resources in a particular area" (Berkes and Henley 1997). According to Swan (2010), 'management' in these definitions, concerns the decision-making processes on what (largely technical) actions are to be taken to sustainably use and conserve natural resources while in a co-management system, these decisions are made by more than one stakeholder. In fact, increasing devolution of power and authority from state to other local communities happens in co-management (Fig. 1.2). In the South Asian context, co-management is widely used to describe a situation where a partnership is developed with other relevant stakeholders that specifies and guarantees their respective functions, rights, responsibilities with regard to protected areas (Borrini-Feyerabend 1996). The history of co-management in South Asia has been long, but the systematic approach to its management is recent (Rao 1997).

Buck et al. (2007) commented that effective conservation is possible even without strict protected area regulations by implementing community-led management, because it is the logical approach to solving resource management problems through partnerships as recently assessed by many researchers (e.g., Kloss 2001; Carlsson and Berkes 2005; MacMillan and Leader-Williams 2008; MacMillan and Phillip 2010). Much of the world's forest areas are already under local community control while community conserved forest landscapes identified in Africa, Asia and Latin America total at least 370 million ha, a greater area than the world's public protected areas (Molnar et al. 2004). In the recent past, a paradigm shift in conservation has refocused resource management strategies on restricting human involvement towards encouraging the involvement of local people (Borrini-Feyerabend 1997; Kiss 1990). For instances, in Australia, Kakadu National Park and Uluru-Kata Tjuta National Park in the Northern Territory and Booderee National Park in the Jervis Bay Territory are managed jointly with their aboriginal traditional owners (Parr et al. 2008). Ianni et al. (2009) reported the efficacy of participatory forest planning within *Kolla* aboriginal community of Yungas Biosphere Reserve in northwestern Argentina. Efficient biodiversity management and sound community development have been noticed in Moheli Marine Park of the Comoros Islands in the West Indian Ocean after implementation of co-management approach (Granek and Brown 2005). Baral and Heinen (2007) reported the successful story of decentralized participatory conservation (co-management approach in other sense) in Bardia National Park, Nepal, while Rodgers et al. (2002) revealed the efficacy of joint management of Karamoja forests by the *Iik* community in northeastern Uganda. Local people's participation greatly improved people-park collaboration in Triglav National Park, Slovenia (Rodela and Udovo 2008), which is most important for sustainable development. Mbile et al. (2005) remarked that the management process of Korup National Park, Cameroon comprising protection, community involvement, research, monitoring, ecotourism and administrative aspects, must be viewed as a 'development process'. Co-management of the sand eel fisheries in Ise Bay is a famous case in Japan, where natural resource management is carried out through the interplay of fisher communities, science and government (Ashida 2009). The stakeholders of the Devi Ki Rao watershed in Jainti, India are managing the community-owned forest for sustainable production that results in the phenomenal increase in the income of beneficiaries from the sale of forest products (Grewel et al. 2001).

1.5.5 Protected Areas in Bangladesh

Declaration of PAs has long been the most effective and widespread measure for conserving nature and natural resources around the world (Mukul 2007), which cover 11.5 % of the earth's land surface (Chape et al. 2003) and only 5 % of the tropical forest area (Dupuy et al. 1999). The Bangladesh government realized the weakness of conventional forest management and continued depletion of forest

resources and started to establish PAs in its national forests since 1960. The first declaration of PAs was under the provision of the Forest Act 1927, which got the momentum after the enactment of the Bangladesh Wildlife (Preservation) Order 1973. With the course of this Order, the government articulated national responsibility for the conservation of wildlife species, their habitats as well by allowing the designation of two IUCN categories of PAs: national parks and wildlife sanctuaries, corresponding to the IUCN categories II and IV, respectively (IUCN 1994). Till to date, there are 34 PAs in Bangladesh and one more has been proposed and on its way to be announced likely. Among these, 17 are national parks, and 17 are wildlife sanctuaries (Table 1.4). Additionally, there are 5 eco-parks and 2 safari parks in Bangladesh, which have also been recognized as PAs in general. These have been established and managed as such but not declared under any legal provision; rather, established as development projects of the government. Although these are extremely small in comparison to the standard classes of PAs and are designated to serve a 'nature recreation' need rather than a large scale 'nature conservation' need (USAID 2005), are contributing significantly to biodiversity preservation as the ex situ conservation strategy (Mukul 2007).

1.5.5.1 Co-management Initiatives in Bangladesh's Protected Areas

In Bangladesh, people's participation in forest management started in 1979 as *Betagi-Pomora* Community Forestry Project on government owned denuded hilly forest land. Subsequently, a number of projects of participatory forestry had been executed by the FD. Realizing the success of people-oriented programmes as in social forestry in Bangladesh (Rana et al. 2007; Muhammed et al. 2005, 2008b), the FD launched a co-management programme as Nishorgo Support Project (NSP) in the country's protected areas in 2004 with the financial assistance of USAID (Sharma et al. 2008). Initially the project was implemented in five pilot sites, viz., Lawachara National Park (LNP), Satchari National Park (SNP), Rema-Kalenga Wildlife Sanctuary (RKWS), Chunati Wildlife Sanctuary (CWS) and Teknaf Wildlife Sanctuary (TWS). NSP aims to collaboratively develop co-management agreements leading to measurable improvements in forest and resource conservation in pilot PAs and their buffer zones with some specific objectives (Nishorgo 2008).

People's participation becomes effective when the right incentives are offered to and roles are clearly defined of the participants (Sawhney et al. 2007). In Bangladesh, the co-management actors are the FD as the legal management authority of PAs and the local and national stakeholders of forest resources. Of them, local stakeholders are basically the poor ones who mainly depend on those forested areas for subsistence livelihoods. But, the activities of socially and economically powerful forest destroyers stand against the poor local communities. Considering the objectives, institutional structures were formed officially in the name of Co-management Council and Co-management Committee (CMC) for the five pilot sites, according to the proposition of NSP in 2006 (Bangladesh Gazette

Table 1.4 List of protected areas of Bangladesh (Nishorgo 2008)

Protected Areas		Geography	Forest type	Area (ha.)	Date of establishment
National Parks (NP)	Bhawal NP	Hilly	TMDF	5,022.00	May 11, 1982
	Modhupur NP	Plain	TMDF	8,436.00	February 24, 1982
	Ramsagar NP	Plain	TMDF	27.75	April 30, 2001
	Himchari NP	Hilly	TMEF	1,729.00	February 15, 1980
	Lawachara NP	Hilly	TMEF	1,250.00	July 7, 1996
	Kaptai NP	Hilly	TMEF	5,464.00	September 09, 1999
	Nijhum Dweep NP	Littoral	MNGF	16,352.23	April 8, 2001
	Medha-Kachhapia NP	Hilly	TMEF	395.92	August 8, 2008
	Satchari NP	Hilly	TMEF	242.91	October 15, 2005
	Khadim Nagar NP	Hilly	TMEF	678.80	April 13, 2006
	Baraiyadhala NP	Hilly	TMEF	2,933.61	April 6, 2010
	Kuakata NP	Littoral	MNGF	1,613.00	October 24, 2010
	Nobabgonj NP	Plain	TMDF	517.61	October 24, 2010
	Shingra NP	Plain	TMDF	305.69	October 24, 2010
	Kadigarh NP	Plain	TMDF	344.13	October 24, 2010
	Altadighi NP	Plain	TMDF	264.12	December 24, 2011
	Birgonj NP	Plain	TMDF	168.56	December 24, 2011
Wildlife Sanctuary (WS)	Rema-Kalenga WS	Hilly	TMEF	1,795.54	July 7, 1996
	Char Kukri Mukri WS	Littoral	MNGF	40.00	December 19, 1981
	Sundarban East WS	Littoral	MNGF	31,226.94	April 6, 1996
	Sundarban West WS	Littoral	MNGF	71,502.10	April 6, 1996
	Sundarban South WS	Littoral	MNGF	36,970.45	April 6, 1996
	Pablakhali WS	Hilly	TMEF	42,087.00	September 20, 1983
	Chunati WS	Hilly	TMEF	7,763.97	March 18, 1986
	Fashiakhali WS	Hilly	TMEF	1,302.43	April 11, 2007
	Dudh Pukuria-Dhopachari WS	Hilly	TMEF	4,716.57	April 6, 2010
	Hazarikhil WS	Hilly	TMEF	1,177.53	April 6, 2010
	Sangu WS	Hilly	TMEF	2,331.98	April 6, 2010
	Teknaf WS	Hilly	TMEF	11,615.00	March 24, 2010
	Tengragiri WS	Littoral	MNGF	4,048.58	October 24, 2010
	Dudhmukhi WS	Littoral	MNGF	170.00	January 29, 2012
	Chadpai WS	Littoral	MNGF	560.00	January 29, 2012
	Dhangmari WS	Littoral	MNGF	340.00	January 29, 2012
	Sonarchar WS	Littoral	MNGF	2,016.48	December 24, 2011

TMDF Tropical Moist Deciduous Forest, *TMEF* Tropical Moist Evergreen Forest, *MNGF* Mangrove Forest

No. pabama/parisha-4/nishorgo-64/(part-4)/112 dated August 10, 2006) with representation from civil society, local government, local residents and resource user groups, and other government agencies. The CMC is primarily responsible for overall management of the PA including the landscape, which includes an area covering 5 km from the boundary of the respective PA. The committee can recruit some members of the community to patrol the forest on a regular basis and pay

them an amount for the services rendered from its own fund. For the financial sustainability of the CMC, there is a provision of turning a portion of the income generated from eco-tourism and other exhibits in PAs over to the committee.

The project applied some strategies with a view to regulating forest use which includes development of different Alternative Income Generation (AIG) activities (Mukul and Quazi 2007) for distributing among local stakeholders forming Forest User Groups (FUG). These AIG activities are, in some cases, ethnicity-specific and varies region to region according to the communities' needs and limitations, offering a number of options as cow fattening both for beef and milk, poultry rearing, nursery production, improved stoves manufacture, nature tourism and eco-lodge, eco-guiding, service enterprises in PAs, elephant rides as tourist amusement, tribal cloths manufacture, date palm leaf based cottage industry, social forestry in buffer zone for poles/logs, fuel wood and medicinal plants cultivation, direct payments for conservation, access to capital such as NGO microfinance, CMC-led microfinance, linkages to existing Micro Finance Institutions (MFIs) and matching grants (DeCosse 2006).

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Chapter 2
Conceptual Framework, Research Methods and Approaches

Mohammad Shaheed Hossain Chowdhury and Masao Koike

2.1 Introduction

Protected areas are the cornerstones of all national and regional biodiversity conservation strategies (UNEP 2004). Aside from their environmental benefits, they can also generate significant economic resources. As such protected areas are crucial for attaining the objectives of the Convention on Biological Diversity (CBD) and meeting the 2010 biodiversity target and the Millennium Development Goals (MDG) (SCBD 2008). The global number and extent of nationally designated protected areas have increased dramatically over the past century (Fig. 2.1) (BIP 2010). According to BIP, by 2008, there were over 120,000 protected areas covering a total of about 21 million square kilometers of land and sea, an area more than twice the size of Canada. While the terrestrial protected areas listed in the World Database on Protected Areas cover 12.2 % of the Earth's land area, marine protected areas currently cover 5.9 % of the Earth's territorial seas and only 0.5 % of the extraterritorial seas. Among nations there is a great deal of variation in protection: only 45 % of the 236 countries and territories assessed had more than 10 % of their terrestrial area protected, and only 14 % had more than 10 % of their marine area protected.

In recognition of the importance of protected areas for the CBD's 2010 target to achieve a significant reduction in the rate of loss of biodiversity, the CBD's Program of Work on Protected Areas aims to establish a comprehensive, ecologically representative and effectively managed network of terrestrial protected

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M. S. H. Chowdhury (ed.), *Forest Conservation in Protected Areas of Bangladesh*, World Forests 20, DOI: 10.1007/978-3-319-08147-2_2,

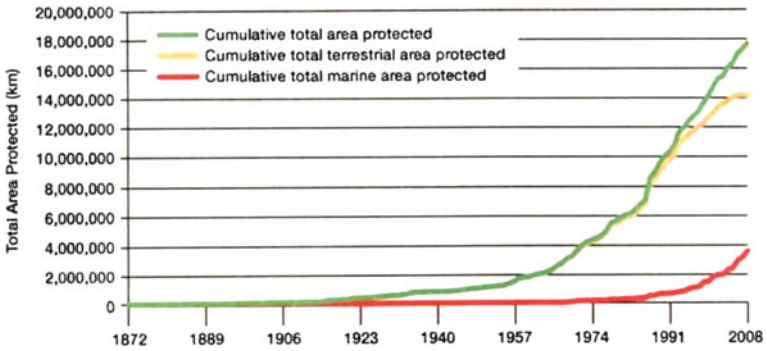

Fig. 2.1 Growth in nationally designated protected areas from 1872 to 2008 (Adapted from BIP 2010) (Graph excludes protected areas with unknown year of establishment)

areas by 2010 and of marine protected areas by 2012. Increasing the coverage of protected areas can contribute to achieving the 2010 target (BIP 2010). Taking this into consideration, many tropical developing countries, where biodiversity is presumably greatest and where local communities rely on it for sustaining livelihoods, have also expanded markedly their amount of land under protected areas, an attempt to address growing concerns on conservation (Naughton-Treves et al. 2005). Bangladesh is also of no exception. But experience showed that in many cases, simply setting aside protected areas does not produce the positive conservation outcomes expected, due to their purely ecological focus and exclusion (or low recognition) of local rights and practices (Mukul et al. 2010). Therefore, the concept of integrating local stakeholders by their active participation in the overall system of conservation has been evolved as an effective means of protected area management. Baral and Heinen (2007) informed that this idea- quite popular in political science- has become ubiquitous in the lexicon of conservation as well as development fields. They also notified the emergence of various conservation models emphasizing devolution of power to local communities and solicitation of people's participation to manage protected areas after the World Parks Congress in Bali, Indonesia in 1982. The movement gained momentum when the Rio Declaration on Environment and Development stated that "*environmental issues are best handled with the participation of all concerned citizens at the relevant level*" (IUCN 1982).

Zachrisson (2010) remarked that beyond simply 'consulting' local people, co-management processes are to be set up to jointly develop management plans, rules and corollary agreements; to formalize benefit-sharing arrangements; to develop the capacities of all stakeholders; to help to set up suitable pluralist management organizations; and to formalize the sharing of authority and responsibility in managing the protected area at stake. By recognizing both the mandate of the state and the needs and concerns of local communities, it is expected for collaborative management to reduce destructive conflicts and mobilize state and local knowledge, skills, resources and institutions towards mutually agreed goals.

Bangladesh's protected areas have been in the interspersion of human habitation since the time immemorial and local communities, as elsewhere in developing world, obtain a large proportion of their livelihoods from these conservation areas. With the course of time, higher population densities and relatively lower per capita income make the maintenance of protected areas one of the most critical issues accompanying a high rate of deforestation (DeCosse 2006). In that circumstance, the government of Bangladesh introduced an alternative strategy of co-management involving local stakeholders and provision of incentives in terms of Alternative Income Generation (AIG) supports under a donor assisted project. This new policy is being implemented in five pilot sites (Satchari National Park, Lawachara National Park, Rema-Kalenga Wildlife Sanctuary, Chunati Wildlife Sanctuary and Teknaf Wildlife Sanctuary) with six specific objectives, viz., developing a functional model for formalized co-management of protected areas, creating alternative income generating opportunities for key local stakeholders, developing policies conducive to improved protected area management and building constituencies for further these policy goals, strengthening the institutional systems and capacity of the Forest Department and key stakeholders so that improvements in co-management under the project can be made permanent, building or reinforcing the infrastructure within protected areas that will enable better management and provision of visitor services at protected areas, and designing and implementing a program of habitat management and restoration for protected areas (Nishorgo 2008).

Sikor (2006) articulated that apart from being the means of effective biodiversity conservation strategy, the approach of collaborative management overall, in protected areas in particular, is viewed as an alternative for the development of communities inhabiting 'the areas of sustainable use by smallholders'. Muhammed (2006) commented that research on community development, especially the socio-economic aspects of rural community requires careful considerations on the complex entities of the society and social investigation facilitates and understanding of the complex interactions between humans and nature. In this regard, Sustainable Livelihoods Approach (SLA) is viewed as the best-suited framework in analyzing community livelihoods. The SLA has emerged as an alternative way of conceptualizing poverty alleviation, including its context, objectives and priorities and rooted in research on agro-ecology and natural resource management (Castro 2002). This approach is simple, widely accepted and applied by the researchers, and combines both the qualitative and quantitative data to fully understand people's livelihoods at the local level (Nath and Inoue 2010). Concurrently, recognizing the expansion of the protected areas' mission from biodiversity conservation to improving human welfare, Naughton-Treves et al. (2005) emphasized on the greater attention to the broader policy context of biodiversity loss, poverty and unsustainable land use in developing countries. Therefore, this book discusses the findings of a number of studies that have been conducted to address the aforesaid critical issues of nature-society interface in Bangladesh.

2.2 Objectives of the Studies

The study has been carried out with the following objectives:

1. Critical review and analysis of the forest policies of Bangladesh highlighting protected areas and biodiversity conservation (Chap. 3).
2. Investigate the major resource utilization patterns from protected area (Chaps. 4 and 5).
3. Examine the impact of collaborative protected area management on community development (Chap. 6).
4. Assessment of people's participation in and community attitudes towards co-management initiatives (Chap. 7).
5. Explore the role of co-management organizations in protected area governance (Chap. 8).
6. Explore the potential of traditional agroforestry-based local livelihoods in biodiversity conservation (Chap. 9).
7. Critical review of the global state of protected area co-management and comparison with that of Bangladesh (Chap. 10).
8. Investigate the patterns and extent of potential threats to protected areas (Chap. 11).

2.3 Study Areas

This is a multi-regional study involving few protected areas of Bangladesh (Fig. 2.2) and hence the study sites were not homogeneous in size, nature and/or characteristics. The main focus was concentrated to Rema-Kalenga Wildlife Sanctuary (RKWS), one of the five pilot sites of co-management project. This sanctuary remains remote and inaccessible to visitors, particularly during the monsoon, due to the lack of proper roads (NACOM 2003). Because of this poor transportation, the extent of previous study on its various dimensions is little while huge researches are available on the other four. Therefore, this protected area was selected deliberately for the detail study. Apart from this, Lawachara National Park (LNP) and Chunati Wildlife Sanctuary (CWS) were chosen as the accompanying study. Moreover, another empirical study was conducted on all the 34 protected areas to assess the potential threats to the conservation strategies, by interviewing the protected area managers through e-mail.

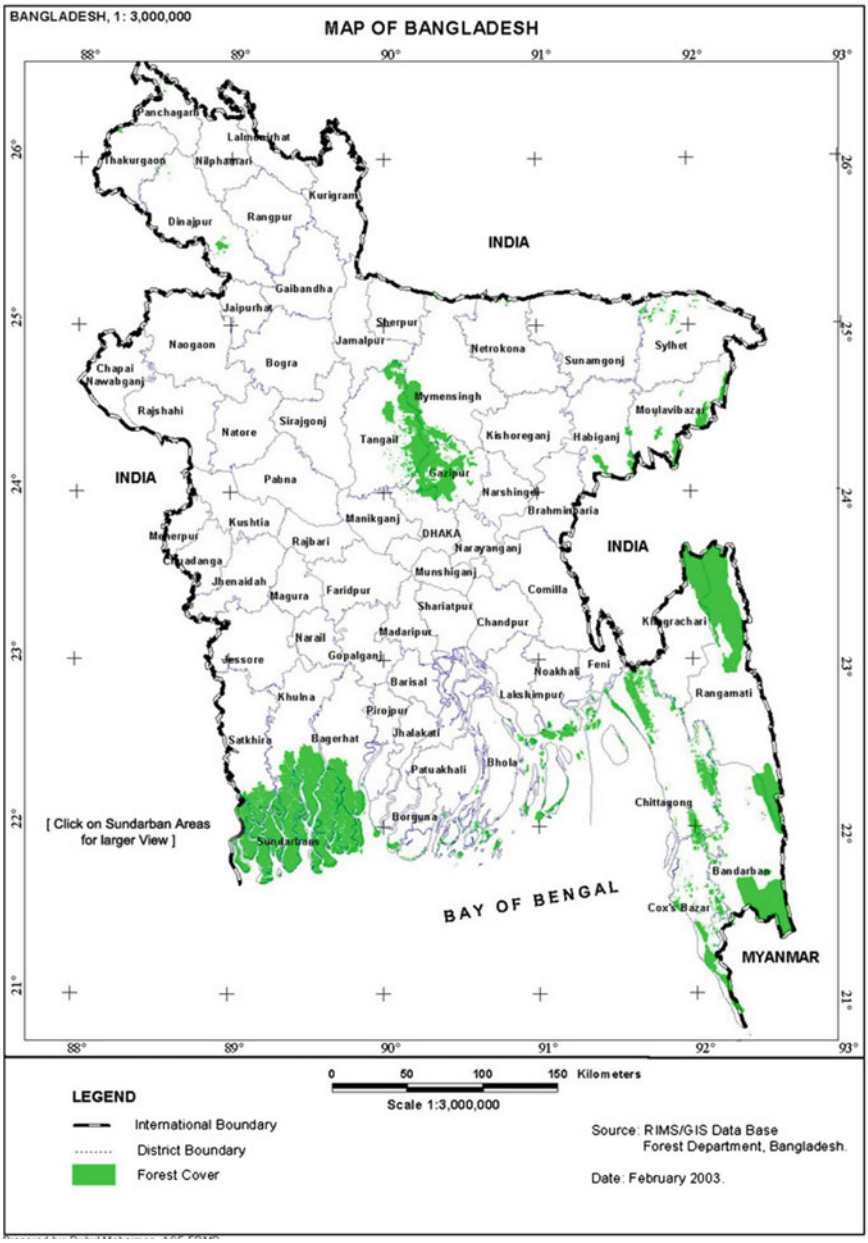

Fig. 2.2 Map of Bangladesh showing the distribution of protected areas (marked *green*)

2.4 Methodology

2.4.1 Critical Review and Analysis of Bangladesh Forest Policy

In the history of Bangladesh forestry, there are a total of five forest policies starting from the British colonial period through the Pakistan period to the period of Bangladesh itself. The forest policies formulated in these periods were reviewed and analyzed considering the time spans of 1760–1947 as the British colonial period, 1947–1971 as the Pakistan period and 1971-onwards as the Bangladesh period. The Forest Policy 1894 (the British colonial period), Forest Policy 1955 and Forest Policy 1962 (the Pakistan period), and Forest Policy 1979 and Forest Policy 1994 (the Bangladesh period) were taken into consideration for this rigorous critical review. Although the forest policies generally address almost all the aspects of forestry, we concentrated only on the conservation and participation aspects as protected area and co-management matters are directly related to these two issues, respectively. The evolutionary history of and periodical changes in the forest policies accompanied by the gradual shifting from the very production principles to the protection ones were analyzed critically. The previously published works, various government and project documents, discussion with the experts in various levels of Forest Department along with the available literatures on the forest policies in international level were the key sources of this review activity.

2.4.2 Community Survey for Assessing Community Development in RKWS

2.4.2.1 Brief Outline About RKWS

Rema-Kalenga Wildlife Sanctuary (Fig. 2.3) is situated in Gazipur and Ranigaon unions (small administrative unit of local government) of Chunarughat upazila (sub-district) in Habigonj district. It is under the jurisdiction of Habigonj-2 Forest Range of Sylhet Forest Division locating approximately 130 km east-northeast of the capital Dhaka and 80 km south-southeast of Sylhet city. The sanctuary lying between 24°06′–24°14′N latitude and 91°34′–91°41′E longitude (BCAS 1997), is bounded by Tripura State of India to the south and east, Kalenga Forest Range to the north and west, and tea estates to the southwest. Bio-ecologically it falls under the Sylhet Hills zones as part of the Tarap Hill Reserve Forest, 1095 ha of which was designated as wildlife sanctuary first in 1982 and expanded further to 1995 ha in 1996 under the Bangladesh Wildlife (Preservation) Order 1973.

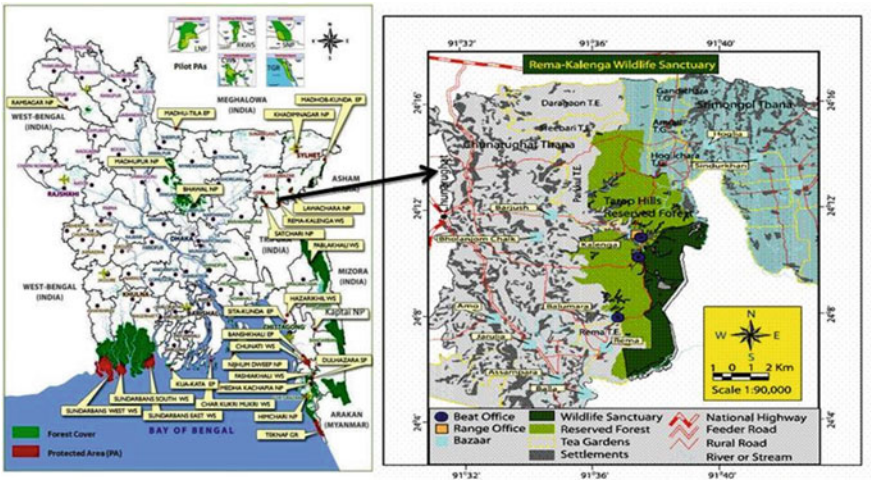

Fig. 2.3 Map of Rema-Kalenga Wildlife Sanctuary, Bangladesh

The sanctuary is divided into three beats (small administrative units of Forest Department) namely Rema, Chonbari and Kalenga. It encompasses several hills of various elevations and low-lying valleys, with the highest peak at about 67 m above sea level. The area enjoys a moist tropical climate characterized by a period of high rainfall from April to September and a five month relatively dry period from November to March (Rizvi 1970). The forest of Rema-Kalenga was declared as wildlife sanctuary considering its biodiversity values and conservation needs (NACOM 2003). It is characterized as tropical evergreen and semi-evergreen forest housing a total of 606 plant species (242 herbs, 120 shrubs, 147 trees and 97 climbers) (Uddin 2001) and 167 wildlife species (119 are birds, 21 mammals, 20 reptiles and 7 amphibians) (Roy and Azam 1995).

Settlement history of Tarap Hill Reserve Forest that surrounds Rema-Kalenga Wildlife Sanctuary goes back to 40–100 years (NACOM 2003). A total of 36 villages having varying degrees of stake with the sanctuary have been identified; one located inside, nine at the boundary and 26 are outside (NSP 2009). The households living in villages inside and adjacent the forest are registered with the Forest Department and recognized as Forest Villagers. Eight of them are inhabited by a number of ethnic communities like *Tripura*, *Santal*, *Urang*, *Kharia*, *Kurmi*, *Goala*, *Munda* and *Bunargi* among whom Tripura makes up approximately 90 % of the total ethnic population (Uddin and Roy 2007). DeCosse (2006) estimated that the total population of these villages is 24,000, 90 % of whom are poor or ultra-poor. He doubted that if the project was to allocate its entire budget to address this huge population, the impact would be negligible. That is why; NSP formed the Forest User Groups (FUG) consisting average number of 12 members selected amongst the most deprived people from the surrounding communities (NSP 2006). A total of 67 FUGs were formed all over the 36 villages and among

them 30 groups are of female stakeholders. The primary occupation of the people living both inside and outside the sanctuary is agriculture, whereas collection of forest resources holds the secondary livelihoods based on which they are categorized into 12 primary stakeholders groups including fuel wood collectors (NSP 2006).

2.4.2.2 Sampling Methods

This was a micro-approach study, conducted among the members of the FUGs of Rema-Kalenga Wildlife Sanctuary (RKWS) in the months of January and February 2009. Multi-stage partly random sampling was used in the study. A preliminary discussion was carried out at the Forest Range Office located in RKWS with the Forest Department officials, members of co-management committee and local leaders of the community. The objective of the discussion was to provide information on the work intended, collect an overall picture of the various stakeholders and forest-dependent local community and to select a village guide. In this stage, participatory appraisal was applied to draw the community sketch with the active involvement of local people (Figs. 2.4 and 2.5). A potential and experienced middle-aged male was selected from the local community as the guide of the research team consisted of four members. The team was headed by the first author; voluntarily assisted by the other three who were the post-graduate students of the Department of Forestry and Environmental Science of Shahjalal University of Science and Technology, Sylhet. The research assistants had the experience of community survey with the background knowledge in forest-people relationship.

Out of 36 villages of varying degrees of stake, five were selected from major stake, two from medium, two from minor-medium and one from minor stake making a total of ten. In terms of position, these villages are distributed as: one from inside, five from adjacent and four from outside the sanctuary. These are *Debrabari* (inside-major stake), *Chanbari* (adjacent-major stake), *Balumara* (adjacent-major stake), *Kalengabari* (adjacent-major stake), *Chakidarbari* (adjacent-major stake), *Jamburachara* (adjacent-medium stake), *Harinmara* (outside-medium stake), *Himalia* (outside-minor-medium stake), *Basulla* (outside-minor-medium stake) and *Krishnanagar* (outside-minor stake). The village size ranged from 18 to 300 households; therefore, we sampled the cent percent households from the villages with major stake and 15–20 % from the others. Out of 67 FUGs, we selected 25 groups at random, five of whom were of female. Finally a total of 302 households were selected randomly for the study. An open-ended semi-structured questionnaire, pre-tested for the intelligibility in the local community, was used for the face-to-face interview of the respondents. It was designed to gather information relating to various socio-economic, demographic and cultural variables. Household heads (male 232, female 70) were the respondents and they were helped by other members of the family as necessary. In the family level, informal meetings were held in the interviewee's home using the native language (*Bangla*), sometimes with the participation of more than one respondent together,

Fig. 2.4 Developing community sketch with participatory appraisals in and around RKWS

Fig. 2.5 Sample of two such community sketches developed on-site

everyone being selected randomly. In addition, one focus group discussion was arranged in each village at the end of the survey in the respective village to know the community perception and cross-check the validity of the opinions recorded during the interviews. Data thus obtained were then organized and analyzed by using SPSS 15.

2.4.2.3 SLA Exercise

The Sustainable Livelihoods Approach (SLA) was followed to assess the development in the community as the impact of co-management in RKWS. It was followed because of its simplification and wider uses by researchers, combining both qualitative and quantitative data to fully understand people's livelihoods at the local level. The SLA was formally introduced by Chambers and Conway (1991), according to whom "livelihood comprises capabilities, assets (both material and social resources) and activities required for a means of living: a livelihood is sustainable which can cope with and recover from stress and shocks

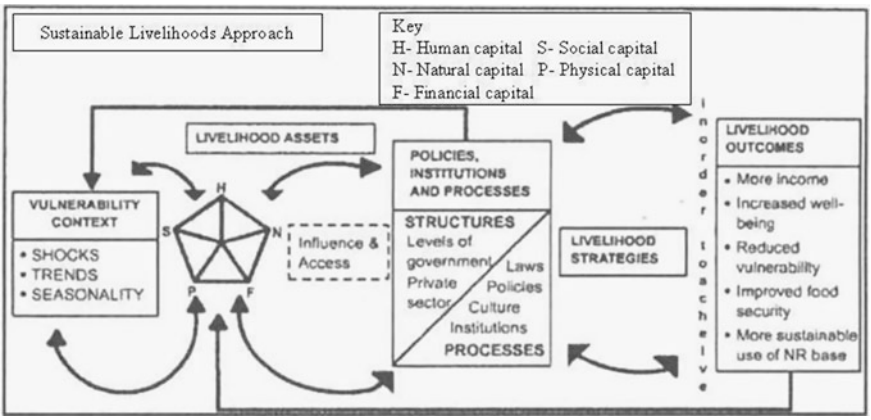

Fig. 2.6 DFID's sustainable livelihoods approach (adapted from Knutsson 2006)

and maintain or enhance its capabilities and assets and provide sustainable livelihood opportunities for the next generation". It offers a fresh vision of holistic and/or integrative approach with the capacity to analyze and understand the complexity of rural development (Solesbury 2003). This tool provides new ways to examine how, in different contexts; sustainable livelihoods are achieved through access to a range of livelihood capitals (human, physical, financial, natural and social) identified in the framework (Scoones 1998). This approach is useful for explaining the interrelationships among various livelihood capitals and their utilization in diversifying livelihood strategies to attain desired outcomes (e.g., increased income and stable natural resource base) in the available enabling environment (Nath and Inoue 2010). An example of such an approach is that used by the UK Department of International Development (DFID) (Fig. 2.6).

Seeing as in this study that there has been a change in the annual income of the respondents after their joining the FUG and the incentives in various form had the contribution in this regard. In order to check whether there is any significant change in the average annual income of the respondents before and after joining the FUG, and whether the allotment of agricultural land (as a prominent incentive) by the FD is significantly contributing to the increase in annual income; paired t-test has been conducted. The hypotheses have been postulated for this purpose, are as follows:

Ho1 There is no significant difference between the respondents' present annual income to the annual income before joining the FUG, and

Ho2 There is no contribution of the amount of agricultural land allotted by the FD to the increases in the respondents' annual income.

2.4.2.4 Likert Scale

For measuring the respondents' attitude about various conservation issues, Likert scale (Likert 1932) was used. Likert scale, named after its inventor, the US organizational behavior psychologist Dr. Rensis Likert, is the method of ascribing quantitative value to qualitative data, to make it amenable to statistical analysis. Likert scales usually have five potential choices (strongly agree, agree, neutral, disagree, strongly disagree) but sometimes go up to ten or more. A numerical value is assigned to each potential choice and a mean figure for all the responses in computed at the end of the evaluation or survey. The final average score represents overall level of accomplishment or attitude toward the subject matter. Although this is mainly used in training course evaluations and market surveys, it has been widely used for assessing the community attitudes on natural resource management, protected and other conservation areas (e.g., Mehta and Heinen 2001; Baral and Heinen 2007; Rodela and Udovc 2008; Pipinos and Fokiali 2009; Nicholas and Thapa 2010). However, in our study, five choices with numerical values from 1 (strongly disagree) to 5 (strongly agree) were used for the application of Likert scale.

2.4.3 Ethno-Botanical Study for Exploring Medicinal Plants

2.4.3.1 Household Survey and Collectors' Interview with Random Sampling

A qualitative approach with ethno-botanical interview was used to gather information. A total of 176 respondents were interviewed among whom 140 were household heads living in and around the sanctuary while the other 36 were the professional collectors of medicinal plant parts from the sanctuary. In case of the respondent selection, all the households under the major stake category and only 13 from the medium stake category were chosen randomly. In addition, 3 focus group discussions were arranged in the tea stalls of local market where the rural people usually get together, gossip and interact in the evening after the day-long business. All the data has been collected from repeated conversations with the respondents to ensure the reliability of the information. This model is what anthropologists know as semi-structured, focalized interview (Pujadas et al. 2004 cited in Parada et al. 2009).

Our main purpose was to obtain the information about medicinal plants used and/or known by the respondents and document the knowledge on their application. The plants used for medicinal purposes were first recorded using local names and conventional *Bangla* names. Although local names of plants vary from region to region in the country, established *Bangla* names have been well documented by Dey (2006) together with the local names. Once local names had been obtained, the corresponding Bangla names were found by reference to Dey (2006). Voucher

specimens of each medicinal plant species were also collected during the field visit and allotted collection numbers. The collected specimens were then dried and identified using standard literatures (e.g., BARC 1972–1922; Chevallier 1996; Das and Alam 2001; Dey 2006) and finally the herbarium vouchers were deposited in the SUST herbarium (Department of Forestry and Environmental Science in Shahjalal University of Science and Technology, Sylhet, Bangladesh).

2.4.3.2 Interviewing Herbal Practitioners with Snowball Sampling

In addition to the household survey and collectors' interview, five professional local herbal practitioners (locally known as *Kabiraj*) were also interviewed. All of them live nearby the sanctuary. In case of the selection of herbal practitioners, snowball sampling (Goodman 1961) was followed that allows recruitment of further samples from the information provided by the randomly selected first sample. Although this sampling technique is often used in hidden populations (e.g., prostitutes, drug addicts etc.) which are difficult for researchers to access, we applied it in the present study because of time constraint.

2.4.3.3 Ethno-Botany Data Analysis Techniques

Apart from the species (with scientific and Bangla names, family and habit), their parts used, and ailments treated; we calculated the relative importance (RI) for each species and informants' consensus factor (F_{ic}) for each disease category.

The relative importance (RI) of the species was calculated according to the following formula (Bennett and Prance 2000), with "2", being the highest possible value, indicating the species that have the greatest number of medicinal properties:

$$RI = NCS + NP$$

where NCS is 'the number of ailment category treated with a given species divided by the total number of ailment categories treated with the most versatile species' and NP is 'the number of individual ailments attributed to a given species divided by the total number of individual ailments attributed to the most versatile species'.

The informants' consensus factor (F_{ic}) was employed to indicate how homogeneous the information is. All citations were placed into ailment categories for which the species was claimed to be used. F_{ic} value ranges from 0 to 1. A high value (close to 1) indicates that the species is used by a large proportion of the informants indicating a consistent use of the medical resources. On the other hand, a low value indicates that informants disagree on the species to be used in treatment within a category of ailment. In other words, the F_{ic} is an indicative value of how consistent the informants are and the extent to which they agree about the use of plant species for treatment of a given ailment or ailment category (Hudaib et al. 2008).

The F_{ic} was calculated adopting Trotter and Logan (1986) according to the following formula:

$$F_{ic} = N_{ur} - N_t / N_{ur} - 1$$

Where N_{ur} is the number of use citations in each ailment category and N_t is the number of species used.

2.4.4 Assessment of Traditional Agroforestry Systems in LNP

2.4.4.1 Brief Outline of LNP

The study was conducted in and around Lawachara National Park, Bangladesh (Fig. 2.7). Geographically the park lies between 24°30′–24°32′N and 91°37′–91°39′E. The area of the park is, 1,250 ha (12.5 km^2), and it is one of the richest forest patches in country marked by diverse wildlife, plants and presence of several indigenous communities living within and on the edge the park. The park originally supported a vegetation cover of tropical wet semi-evergreen forests, even though most of the original forest cover has been removed or substantially altered during the last decades (MacKinnon 1997).

2.4.4.2 Biodiversity Surveys

Surveys for the study were undertaken between February to April 2009 through a series of field visits in the study site. All plots were chosen randomly, deployed either in the forest (i.e., national park or adjoining reserve) or in the boundary of national park having sufficient corridor or connectivity with the park. A total of 50 (10 × 10 m/0.01 ha) rectangular plots were established in the agroforestry land-uses (10 × 4 land-use) and in secondary forest, representing 5 different land-use/land-cover (agroforestry land-uses and indigenous forest cover/land-cover). The survey procedures are briefly described hereafter;

i. **Plants:** All individuals of tree species ≥6 cm at d.b.h (diameter at breast height; 1.3 m above the ground) were considered as tree, other individuals belonging to tree species and ≥1.3 m tall and d.b.h less than 6 cm were considered as sapling. During vegetation survey diameter and height of all trees and saplings within each 10 × 10 m plot were enumerated. Species were identified in the field by local expert and cross-checked following Dey (2006), Das and Alam (2001) and Khan et al. (2001). Four sub-plots of 2 × 2 m size were established within each rectangular plot to record understory vegetation (i.e. herb, shrub, and tree seedlings with height less than 1.3 m).

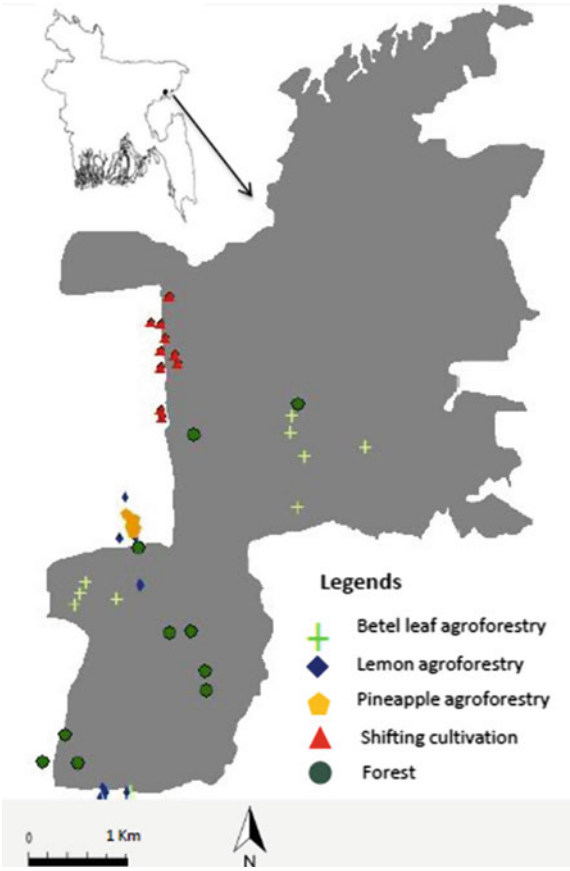

Fig. 2.7 Map of Lawachara National Park with spatial location of the study plots

ii. **Wildlife:**

(a) **Mammals:** Since the primary aim of the study was to compare the mammalian communities at different sites, rather than the calculation of absolute densities, we used only abundance (presence/absence) data as also followed by Lopes and Ferrari (2000). Information on the abundance of mammal species was recorded through arranging visits in pre-established transects within the agroforestry land-uses/cover. Walk was done at a slow pace (approximately 2 km/h) along pre-established trails as per followed by Carrillo et al. (2000), looking for mammal tracks. Abundance index for each species was estimated by dividing the number of sightings (tracks or primate groups) by the length of a given trail.

(b) **Birds:** For bird 15 points (3 × 5 land-uses) with 25 m radius were surveyed for a period of 1 h to assess the diversity and abundance of bird species. Plots were visited in a random and nocturnal birds were excluded from these survey. Most observations were made from the census area

center, with periodic movements within the area to detect and identify cryptic and non-vocal species.

2.4.4.3 Soil Survey

Twenty five soil samples (5 × 5 replicates) were collected from four agroforestry land-uses (5 × 4) and from forests (5 × 1). Plots for soil sampling were chosen alternately with intention to cover all slope and elevation gradient. For each plot 4 soil samples from 0 to 20 (Of-C horizon) cm depth were collected. A composite sample was prepared each plot by mixing soils from four p. Soil sampling for bulk density measurement was done once for each of 25 plots using a standard 178 cm^3 cylinder.

2.4.4.4 Data Analysis

i. **Diversity:** Only abundance (presence/absence) data was used for comparing wildlife diversity. Plant diversity was calculated in terms of species richness in four agroforestry land uses as well as for the forest. Shannon-Weiner biodiversity index (Eq. 1) was used for measuring species richness, and was calculated following Magurran (2004):

$$H = -\sum_{i=1} p_i \ln p_i \tag{1}$$

where, H is the Shanon Index, p_i is the proportion of individuals found in the ith species.

Jaccard's similarity index (I), was used for measuring beta (β) diversity of plants and wildlife, and was used to estimate how similar or different the plants or wildlife of any pair of land-uses (Eq. 2),

$$I = s_{ij}/\left(s_i + s_j - s_{ij}\right) \tag{2}$$

where, s_{ij} is the number of species found in plots i and j, s_i is the species found in plot i, and s_j is the species found in plot j. The index (I) ranges between 0 (no species in common) and 1 (identical species composition).

ii. **Woody biomass:** The model developed by Brown et al. (1989) was used to estimate above ground biomass. This method is suitable particularly for the tropics and was also used by several other authors (e.g. Steffan-Dwenter et al. 2007; Alves et al. 1997). The model is as follows

$$B = \exp.\left\{-2.4090 + 0.9522 \text{ In } \left(D^2HS\right)\right\} \quad (3)$$

where, exp. = [……] means "raised to the power of […….]"; B = above ground biomass in Kg;

H = Height of the trees in meter; D = Diameter at breast height in cm; S = Wood density in units of tonne/m^3.

Below ground biomass was calculated considering 15 % of the above ground biomass (MacDicken 1997).

iii. **Soil organic carbon:** Soil organic carbon was measured as described in Alamgir and Al-Amin (2008). The following calculation was followed;

$$\text{OC } \left(\text{organic carbon gm/ } m^2\text{/horizon}\right) = \left(C \times 10^3\right) \times D \times B \quad (4)$$

where, C is the organic carbon presence (%), D is the depth of soil horizon in cm (here 20 cm); B is the bulk density (in gm/cm^3).

2.4.5 Exploring the Role of Co-management Organizations in CWS

2.4.5.1 Selection of the Case Study Area

The role of co-management in promoting active community participation through community-based institutions for the governance of forest PAs in Bangladesh was a central theme of the case study. The changing patterns of the PA management were studied through the views and perception of the respondents, who were major stakeholders in the Chunati Wildlife Sanctuary (hereafter referred to as CWS). Research and discourse on whether co-management has the potential to facilitate participatory resource management and better governance needs to include community and stakeholder voices. Their perceptions and experiences are important in identifying the role of community-based local institutions in upholding rights, capacity building and facilitating the access of community to participate in PA management. Power relationships and the devolution of power are the core factors in co-management. Whether the present Bangladesh legal and policy frameworks support devolution of power, in reality, was also a focus of the case study. Power in protected area co-management cannot be understood in the abstract. The case study uses qualitative methodologies to investigate these perceptions and relationships in the context of the set research questions.

The main purpose of the empirical research was to gain an understanding of the existing trends of PA management in Bangladesh and the implications for co-management as a governance mechanism through active community participation

under the purview of the CMOs. The CWS was selected as a case study because it was one of the pilot sites where co-management was being implemented by the FD in collaboration with the local community and other stakeholders. Research was carried out in two 'forest ranges'[1] of the CWS: namely Chunati and Jaldi. Two factors were considered while selecting these sites. Firstly, co-management project operation of IPAC was based here. The field study was undertaken over a period of eight months. The first phase extended from July 2010 to December 2010 and the second phase from October 2011 to November 2011.

For analyzing the role of co-management organizations (CMOs) in protected area governance, direct field visits and monitoring of the organizations' activities were conducted in Chunati Wildlife Sanctuary (Fig. 2.8). During the field visits, various stakeholders were interviewed regarding their perception and experiences concerning CMOs. After collecting their opinions and examining the CMOs' activities, a critical analysis was done. The sustainability and functioning of the Co-management Committees (CMCs) as institutions was the central theme of discussion. The CMC members were asked to comment on the role played, or could be played, by these institutions for the improved governance of forest PAs in Bangladesh.

2.4.6 Assessing Communities' View About the Impact of Wildlife Status in RKWS

2.4.6.1 Selection of Respondents

Six villages were selected randomly considering three parameters, viz., village position, degree of dependency on the sanctuary, and ethnicity of the community (Table 2.1). Using a reconnaissance survey and consultations with the local leaders, a list of the FUG households from each village was ascertained. Then from the list, a total of 302 households were selected randomly for the interview.

2.4.6.2 Face-to-Face Interview

An exploratory survey was conducted in the selected households using an open-ended semi-structured questionnaire, pre-tested for intelligibility in the study area beforehand. Both qualitative and quantitative data were collected through face-to-face interviews. Household heads were the respondents and were assisted by other members of the family as necessary. Photographs and drawings of the animals of interest were shown, and their knowledge on species occurrence and natural

[1] It is an administrative unit to manage forest smoothly. Usually run by a range officer that covers some manageable areas of forest.

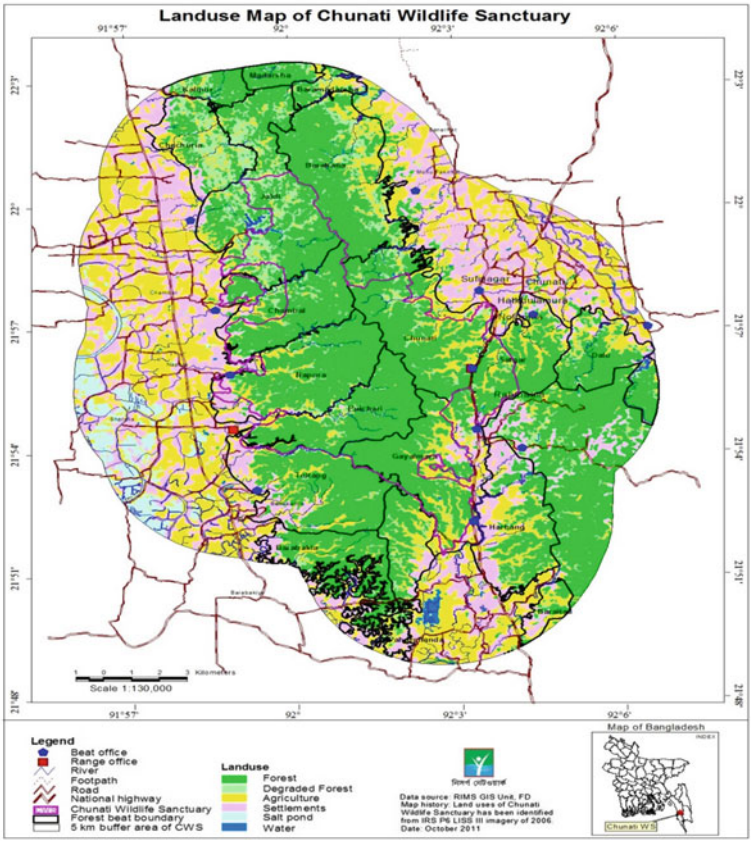

Fig. 2.8 Map of Chunati Wildlife Sanctuary showing various land use areas

Table 2.1 List of the villages selected for the study with three characteristic parameters

Village name	Village position	Degree of dependence	Ethnicity
Debrabari (n = 30)	Inside/core zone	Heavy	Tribal
Chanbari (n = 34)	Adjacent/buffer zone	Heavy	Tribal
Kalengabari (n = 54)	Adjacent/buffer zone	Heavy	*Bangalee*
Jamburachara (n = 48)	Adjacent/buffer zone	Medium	*Bangalee*
Harinmara (n = 84)	Outside/outer zone	Medium	*Bangalee*
Krishnanagar (n = 52)	Outside/outer zone	Low	*Bangalee*

history was recorded. Trophies, skins, and animal originated ornaments and utensils preserved in the respondents' houses were examined. Information on hunting, human-wildlife conflicts, and suggestions on probable solutions were also collected during the interviews. On the family level, informal meetings were held in the interviewee's home using the native language (*Bangla*), sometimes with the

participation of more than one respondent simultaneously. Moreover, six Focus Group Discussions were arranged in six study villages with the active participation of the community members to find the overall perception of the community and cross-check the validity of the opinions recorded during interviews, develop an action plan for formulating framework, and set guidelines for other protected areas of the country.

2.4.6.3 Forest Transect Survey

A transect survey with random walks through the surrounding forests following the standard procedure (NSP 2007) was carried out to observe and assess the status of wild animals and their availability. This survey was also accompanied by the field assistants already recruited. Both the terrestrial bushes and tree canopies were scanned using spotting scopes and binoculars. Indirect signs of wildlife (e.g., foot marks, feces, feathers, horns, nests, burrows, and crop damage patterns) were explored and examined.

2.4.7 Exploring Potential Threats to Protected Areas

2.4.7.1 Electronic Survey of the Protected Area Officials

Information on threats to the protected areas of Bangladesh was collected from field-level protected area managers, who were contacted through an informal letter with the help of the central authority of the country's Forest Department. Managers were asked to list potential threats to the protected areas of Bangladesh, according to their judgments (from their own protected areas and others if they knew them). The results were a variety of statements, many denoting the same kind of threat. By analyzing these 'raw' statements, we summarized the information into a total of ten threats.

A more in-depth follow-up survey was conducted for all 34 protected areas, using a brief structured questionnaire. The questionnaire was sent electronically to respondents, and completed over a period of three months from March to May 2013. The respondents were field-level managers and researchers (three from each protected area), such as Assistant Conservators of Forest, Forest Rangers, and Scientific Officers who were considered to be knowledgeable key informants because of their long acquaintance with the protected areas and their surrounding environment. Respondents from each protected area were asked to score each of the ten key threats numerically from 1 as the lowest threat level to 5 as the highest. They were asked to score the threats independently and were only asked to score threats to the protected areas where they have been working officially.

2.4.7.2 Data Analysis

For data analysis, the methods of Okunlola and Tsujimoto (2009) were followed, and the following threat indicators were calculated:

Protected Area Susceptibility Index (PASI) = The number of threats mentioned for each protected area, divided by 10 (the total number of threats listed), to provide the proportion of threats mentioned for that protected area.

Mean score of each threat factor = Sum of all the scores for that particular threat/Total number of the respondents (102).

Relative Threat Factor Severity Index (RTFSI) = Mean score for a particular threat/The highest possible score (5).

Protected Area Relative Threatened Index (PARTI) = Total score of all the threat factors from the respondents of a given protected area/Total responses (30).

The ranking system based on RTFSI shows the severity of the threats, while the ranking based on both PASI and PARTI shows the vulnerability of protected areas to the identified threat factors. It was assumed that the higher the scores, the more vulnerable the protected area is. A comparison of protected area vulnerability in terms of the forest types they exhibit, and the geographical location they belong to was performed by a non-parametric Kruskal-Wallis test (Zar 1999).

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Chapter 3
Critical Analysis of the Forest Policy of Bangladesh: Highlights on Conservation and People's Participation

Mohammad Shaheed Hossain Chowdhury, Masao Koike and Shigeyuki Izumiyama

Abstract With the history and experiences of more than 100 years in formulation and revisions, since the British colonial period, the forest policy of Bangladesh has turned away from traditional production premises towards protection. Establishing protected areas for biodiversity conservation dates back to the 1960s. The strategy gained impetus with the passage of national legislation in 1973 that included provision of declaring forests as national parks, wildlife sanctuaries and game reserves for the protection of the natural forest resources. Due to the absence of clear demarcation between core areas and buffer zones and the absence of concern for the sustention of local communities' usufruct rights, degradation continued in the protected areas. Therefore, an alternative strategy of co-management involving local stakeholders and provision of incentives in terms of Alternative Income Generation (AIG) supports; has been introduced by the government under a donor assisted project. This new policy is being implemented in five pilot sites. This co-management strategy has demonstrated positive impacts and, increasingly, is gaining recognition as appropriate for other protected areas. This paper reviews the evolutionary history of and periodical changes in the forest policy of Bangladesh—highlighting the conservation aspects, the development of protected areas and the gradual adoption of their collaborative management.

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M. S. H. Chowdhury (ed.), *Forest Conservation in Protected Areas of Bangladesh*, World Forests 20, DOI: 10.1007/978-3-319-08147-2_3,

3.1 Introduction

The people of Bangladesh, with a total land area of 147,570 km^2 and 140 million populations (FAO 2007) have been exerting tremendous pressure on its limited resources. Of the total area, agricultural land makes up 65 %, urban areas account for 8 %, water and other land uses for 10 %, while forestlands account for almost 17 % that includes classified and unclassified state forests and village forests. Of the total 2.52 million ha forestlands, the Forest Department (the legal controlling authority under the Ministry of Environment and Forest; henceforth FD) manages 1.52 million ha of reserved and protected forests. 0.73 million ha, most of which are bare, lack forest cover, and losing topsoil—designated as Unclassed State Forest (USF)—are under the control of Ministry of Land, and the remaining 0.27 million ha are privately owned village forests and are the most productive tree-based resource in the country (BFD 2008). However, according to the Forest Resources Assessment 2005 (FAO 2007), Bangladesh has 871,000 ha of forest area (6.7 % of the total land area) and 279,000 ha plantations. This estimate is much lower than the government estimate and the reason of such discrepancy is explored by Muhammed et al. (2005); part of the discrepancy is due to the FAO estimate including only the designated government reserves, protected forests and the USF—without taking into consideration the privately owned village forests.

Iftekhar (2006) characterized the history of forestry in Bangladesh as deforestation and degradation, occurring for many reasons such as encroachment for agriculture, illegal wood cutting, leaf-litter and fuel wood collection, grazing and browsing, intentional forest burning, uncontrolled and wasteful commercial logging, internal armed conflict, shifting cultivation, and over exploitation. Figure 3.1 depicts the factors responsible for the shrinkage of forest and forest resources in Bangladesh. Muhammed et al. (2005) ascribed the use of land between and within forested areas for housing and agriculture to the tremendous demographic pressure—1,079 people/km^2 (FAO 2007)—and identified this as the preeminent cause accelerating the rate of deforestation with loss of biological diversity—contributing and leading to overall environmental deterioration. Several factors arising from population pressures have led to drastic loss of forest cover in hill forest (Salam et al. 1999) and Sal forest (Alam et al. 2008). Encroachment on to forest land (3.3 % of hill forests, 31.9 % of deciduous Sal forests) is responsible for much of the observed loss (Muhammed et al. 2008a). FAO (2007) assessed the annual rate of negative change of forests as 2,000 ha, or 0.3 % in the period of 2000–2005 over the whole country. Under such pressure, many of the plants and animals either have been extinct or are endangered. IUCN (2000) in its Red Data Book listed a total of 40 inland mammal species, 41 bird species, 58 reptiles and 8 amphibians under various degrees of risk in Bangladesh. Bangladesh National Herbarium also identified 106 vascular plant species under risk of various degrees of extinction in the country (Khan et al. 2001).

Rana et al. (2007) argued that protection of the environment that is crucial for sustainable development in Bangladesh cannot be ensured without proper

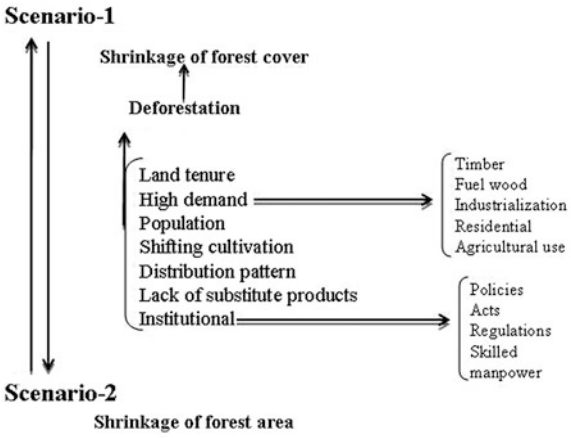

Fig. 3.1 Factors affecting forests and forest resources in Bangladesh (adapted from Muhammed et al. 2008a, b)

management, maintenance and expansion of forest resources. The World Bank (1992) reported the failure of traditional forest management systems in many developing countries to preserve, manage and develop their natural resources; Bangladesh is of no exception. Against such malfunction the creation of large protected areas can be viewed as a fundamental strategy in biodiversity and watershed conservation (Kramer et al. 1997), whilst Schelhas et al. (2002) urged on the effective maintenance of relationships between those areas and the local communities. Recognizing the weakness of conventional forest management and the continued degradation and depletion of forest resources, the Bangladesh government has been exploring different options (Rana et al. 2007): of these, 'the establishment of protected areas' and 'the gradual adoption of community involvement in resource management' are the two important elements as, today, it is believed that, to conserve forest resources effectively and establish protected areas, management systems need to build partnerships with the communities living within or near such protected areas and to address their needs for forest resources in their livelihoods (Lai 2003). Because high degree of dependency that many people have on the forests for their livelihoods has resulted in depletion of forest resources countrywide (Muhammed et al. 2008a).

Although declaration of forests or part of forests as protected area in Bangladesh, under the provision of the Forest Act 1927, has been initiated since 1960—some 10 years before the country's independence, the Bangladesh Wildlife (Preservation) Order 1973 must be viewed as the first comprehensive legislation for the control and management of wild animals including its habitat (Rahman 2004). With the passage of this legislation, the Bangladesh government defined the national responsibility for the conservation of wildlife species. Article 23 of the Order provides for the declaration of protected areas and regulations controlling activities in protected areas. The Order allowed for the designation of three categories of protected areas: national parks, wildlife sanctuaries and game reserves. Now there are 19 protected areas in Bangladesh and one more has been proposed.

Among those, 10 are national parks, 9 are wildlife sanctuaries and only 1 is a game reserve. Covering almost 2 % of the country's total area, the protected areas of Bangladesh cover 11 % of the total forest area, on an average, 5 % of the hill forests, 11 % of the Sal forests and 23 % of the mangrove forests being protected (Mukul 2007; BFD 2008).

In addition, there are 5 eco-parks and 1 safari park, which have been established and managed as development projects of the government's Ministry of Environment and Forest, but not declared under any legal instrument. These are extremely small by comparison to the scheduled protected areas, and are designed to serve "nature recreation" needs rather than large scale conservation needs (USAID 2005).

People's participation in forestry activities started formally in Bangladesh in the 1980s with the initiation of a FD forestry extension program on national forestlands (Rana et al. 2007). As an alternative to traditional forest management, people-oriented forestry has been introduced there in order to increase the country's forest cover (Muhammed et al. 2008a). With the disappearance of more than 50 % of the country's forests in the last 30 years and the protected areas' being critically threatened (Nishorgo 2008), co-management with the collaboration of local communities has emerged. Because protected areas in Bangladesh have been in an intimate interspersion of human habitations; and cultivation through them with traditional dependency on forests is a long timed episode. As international policies concerning protected areas have changed from classic, scientific and exclusionary approaches to more human-centered models, often based on neoliberal economic precepts (Berkes 2004), the Bangladesh government has responded with realism and formulated policies and implemented strategies for conservation recognizing the necessity for the active involvement of local communities in all management decisions and activities.

3.2 The Evolution of Forest Policy

Bangladesh, itself, evolved through a long process of political and administrative change over several centuries (Fig. 3.2). As part of greater India, Bangladesh was colonized by Britain from 1760 until 1947. Following independence from colonial rule, Bangladesh became a part of Pakistan and remained so until its emergence as an independent nation in 1971 (Rasul 2005). This section is based on the authors' review of the published works and government and project documents highlighting the trends of changes in forest policies and legislations towards a collaborative management approaches for protected areas. The review has been carried out under the following broad periods starting with the British colonial period followed by the Pakistan period and finally the post-independence period.

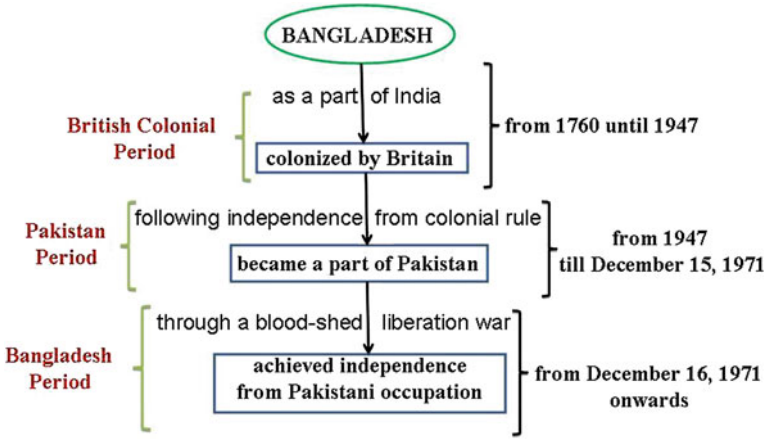

Fig. 3.2 The evolutionary history of Bangladesh as a sovereign state (at a glance)

3.2.1 The British Colonial Period (1760–1947)

The historical development and evolution of the public forest policies and practices in the Indian subcontinent (including Bangladesh) manifest two interrelated trends: (i) state-sponsored, organized commercialization of forestry; and (ii) progressive alienation of forest-based communities from forest use and management (Khan 2001). Simultaneously, agriculture was prioritized above forestry leading to forest clearance which was initiated from the very early times in the continent's history. SAWTEE (2002) reported the evidence of clearing forestlands for agriculture during the *Mughal*[1] period (1526–1700). The end of the *Mughal* period was followed by the ushering of a series of independent Bengal *Nawabs*[2] and the arrival of the British with the subsequent establishment of the East India Company. Under colonial rule and up until the middle of the nineteenth century, forests of the sub-continent were subject to exploitation on a gigantic scale for ship building and railway sleepers without concern for forest preservation and development (Mustafa 2002). The first instrument guiding the policy issues, the Charter of Indian Forests was promulgated as early as 1855 recognizing the importance of reserve forests (CPD 2002). However, Mustafa (2002) reported the actual beginning of forest conservation in Bengal with the appointment of M. T. Anderson as Conservator of Forests for the Lower Province, i.e., Bihar, Orissa, Bengal and Assam, and the creation of the first Forest Department in 1864 (Rangarajan 2003). The first Indian Forest Act 1865 classified the forests and legalized and constituted reserved and protected forests. In 1869, an Assistant Conservator of Forests was

[1] The Muslim dynasty founded by Emperor Baber that ruled India.

[2] The provincial governor of a province or region of the *Mughal* Empire.

appointed to select forests suitable for reservation in the Chittagong hills and subsequently, in 1871, some 5,670 miles^2 out of a total of 6,882 miles^2 within the district, had been gazetted as government forests. This has been viewed as the first attempt by the State towards the conservation of forests in the territory of Bangladesh. The Elephant Preservation Act in 1879 demonstrated the wish of the rulers for wildlife conservation (USAID 2005). This conflicted with the policy of establishing state control over the forests by declaring almost all of them in the Chittagong Hill Tracts to be government property and opening them to commercial exploitation (Rasul 2005). Rasul also reported on an increase in annual average revenue from forest products after 1871 as a result of these aggressive forest exploitation policies.

One of the key elements of a policy process is its ability to link directly experiments and new ways of making things work on the ground (Mayers and Bass 1999). In Bangladesh itself—as distinct from all India—the development of the National Forest Policy is the oldest. The first policy was formulated in 1894 and the most recent modification was approved in 1994 (Chowdhury 2003). British India's first forest policy was enacted in 1894 (Circulation No. 22-F dated October 19, 1894) and established the preference to agriculture over forestry, proposing that "demand for cultivable land can be, to some extent, met by clearing forest areas" (Hussain 1992; Khan 2001). It focused on earning revenue as the key objective for the management of public forests by restricting the rights and privileges of their users (CPD 2002; Mustafa 2002), and framing rules to that end, based on that policy; the Forest Act 1927 came into being (CPD 2002). The legal classification of major forest-related rules (forest manual, transit rules, stumpage appraisal, etc.) was framed after this policy. Muhammed et al. (2008b) conceded while these rules helped bring forest management under official control, their main purpose was to maximize forest revenue by introducing feudal lords to oversee various forest regions. However, an important element in the forest policy of 1894 regarding the preservation of forests was the directive to maintain forests in hilly areas for the preservation of climatic and physical conditions, and for the protection of cultivated land in the plains below from siltation, soil erosion, floods etc., as well as the devastating effects of torrents (Mustafa 2002). In the meantime, two other legislative instruments directed at wildlife conservation were the Wild Bird and Animals Protection Act in 1912 and the Bengal Rhinoceros Preservation Act in 1932 (USAID 2005; BFD 2008).

3.2.2 The Pakistan Period (1947–1971)

In 1947, the start of the dissolution of the British Indian Empire led to the creation of the sovereign states of the Dominion of Pakistan and the Union of India. Bangladesh was included in the Dominion of Pakistan with the name East Pakistan, although there was a physical separation of a thousand miles between the two wings, and the Bangladesh part being surrounded by Indian Territory to its three

sides. Since the forest policy of 1894 had been framed for the 19th century forest resources—in rich pre-partitioned British India—a reassessment of policy was required to address the needs of the contemporary situation. While the forest policies in the Pakistan period were seen as a continuation and outcome of the colonial rule exhibiting similar characteristics (Khan 2001; Rasul 2005), the forest policy of 1955 depicted some important issues—especially those emphasizing the conservation of forest resources. The significant statements of this policy include

- forests should be classified on the basis of their utility and forestry should be given a high priority in national development plans,
- provision should be made to manage all forests under working plans,
- the beneficial aspects of forestry should be given precedence over commercial motives,
- habitat protection and improvement should be given priority to protect and conserve wildlife,
- necessary powers should be given to control land-use under a coordinated programme of soil conservation and land utilization in areas subject to or threatened with soil erosion,
- a properly constituted forest service of fully trained staff should be made responsible for the implementation of forest policy.

The primacy given to the non-quantifiable benefits of forestry over commercial motives, and the priority given to habitat protection and improvement in the protection and conservation of wildlife reflected trends that had been strengthening for some time in the country's forestry sector. The provision to manage all forests under prescribed working plans was maintained for the first time here (Hussain 1992) and was considered to be a significant achievement under this policy (Muhammed et al. 2008b). Nevertheless, in the Pakistan period, forest policies vacillated with the forest policy of 1962 again stressing commercial motives for forest management rather than conserving nature was a theme seen throughout the region (Fig. 3.3).

The most noteworthy features of this policy were:

- managing forests intensively and as a commercial concern,
- improving utilization of forest products, reducing rotation, and promoting regeneration so as to keep pace with increased harvesting,
- conducting research on fast growing commercial species for each ecological zone to encourage farm forestry,
- conserving soil on a priority basis in forests and private lands.

In the forest policy of 1962, the statement of managing forests intensively for commercial concern expressed the firm intension of the state to use forests as the source of revenue that has been conveyed by the other assertions also. It seems the initiation of an emphasis on conservation in the forest policy of 1955 had been nipped in the bud in the policy of 1962. However, a conservation effort restarted in 1966 when the government invited World Wildlife Fund (WWF) to assess its wildlife resources and recommend measures to arrest their depletion (SDNP 2008).

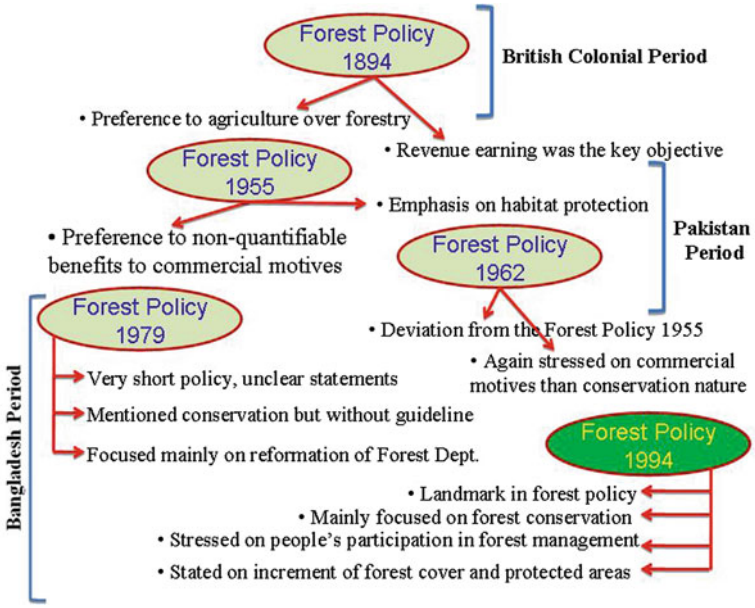

Fig. 3.3 The changes (from production to protection principles) in the forest policies of Bangladesh over time

Two missions were carried out (Mountfort and Poore 1967, 1968) and the severity of the situation was confirmed; the government then established its own Wildlife Enquiry Committee in 1968 and by 1970 the committee had prepared a report (SDNP 2008). The part relating to the then East Pakistan (presently Bangladesh) was published as a separate report (GoEP 1971). Considerable progress was made with the establishment of several protected areas (Mountfort 1969); research was undertaken on the Sundarbans tiger population of the then East Pakistan (Hendrichs 1975) and technical inputs were received from UNDP/FAO (Grimwood 1969).

3.2.3 The Post-independence Period (1971 Onwards)

In 1971, after the liberation of Bangladesh from Pakistani occupation, it was challenging for the new government to receive multi-lateral donor funding, including funds to address long term wildlife projects and conservation issues throughout the country. In that circumstance, viewing that all the previous legislations were ineffective in preserving wildlife, his government promulgated the Bangladesh Wildlife (Preservation) Order 1973. With the enactment of the Order, all the previous acts regarding preservation of wildlife such as the Elephant

Preservation Act 1879, the Wild Birds and Animals Protection Act 1912 and the Bengal Rhinoceros Preservation Act 1932 have been repealed (BFD 2008). While assurance of the existence of adequate legal strategies and institutional arrangements is considered necessary for a sound and lasting protected area program (Mackinnon et al. 1986), the Bangladesh Wildlife (Preservation) Order 1973 provided broad legislation for the protection of areas and species in Bangladesh but included the following:

- National Park: means comparatively large area of outstanding scenic and natural beauty with the primary object of protection and preservation of scenery, flora and fauna in natural state to which access for public recreation and education and research may be allowed (Article 2(h)).
- Wildlife Sanctuary: means an area closed to hunting, shooting or trapping of wild animals and declared as such under Article 23 by the government as undisturbed breeding ground primarily for the protection of wildlife inclusive of all natural resources, such as vegetation, soil and water (Article 2(p)).
- Game Reserve: means an area declared by the government as such for the protection of wildlife and increase in the population of important species wherein capturing of wild animals shall be unlawful (Article 2(c)).
- Private Game Reserve: means an area or private land set aside by the owner thereof for the same purpose as a game reserve and declared as such under Article 24 (Article 2(i)).

Among these four categories, the first three correspond to the IUCN categories II, IV and VI, respectively (IUCN 1994). 'Private game reserve', as mentioned above, is not recognized by IUCN; however, under Article 24 of the Order, provision is made for its establishment upon application by the land owner where the owner of a private game reserve may exercise all the powers of an officer provided under the Order. In Bangladesh invariably all the protected areas declared under the Bangladesh Wildlife (Preservation) Order 1973 are 'reserved forest' designated under the Forest Act 1927 and are defined as 'the forests where everything is prohibited unless permitted' (Rahman 2004).

According to the Article 23 of the Order hunting, killing or capturing any wild animal within a national park or one mile (1.6 km) of its boundaries, causing any disturbance (including firing of any gun) to any wild animal or its breeding place; felling, tapping, burning or in any other way damaging any plant or tree; cultivating, mining or breaking up any land; and polluting water flowing through a national park are not allowed. Similarly entry or residence, cultivation, damage to vegetation, killing or capturing wild animals within one mile (1.6 km) of the boundaries, introduction of exotic or domestic species of animals, lighting of fires, and pollution of water are not allowed in wildlife sanctuary. Under Article 23, wildlife sanctuaries enjoy a greater degree of protection than national parks. For example, entry or residence, introduction of exotic or domestic species of animals and lighting of fires is prohibited in wildlife sanctuaries, but not in national parks; no specific rules are detailed for game reserves (SDNP 2008).

The Order was amended, elaborated and re-enacted in 1974 with the title Bangladesh Wildlife (Preservation) (Amendment) Act 1974 (Islam 2004). The three schedules attached to the 1974 enactment contain lists of different animals with varying degree of protection (GoB 1973; Islam 2004; SDNP 2008). Part I of the First Schedule includes 3 species of amphibians, 3 reptiles, 27 birds and 3 mammals. It also includes the crabs. Animals that are listed under this part are open to shooting and may be hunted on an ordinary hunting permit [but from 1998, issuing of hunting permit has been closed by the order of government (BFD 2008)]. Part II of the First Schedule specifies a number of reptiles, birds and mammals the hunting of which requires a special permit, e.g. permits may be issued when an increase in these animals threatens the balance of nature of a particular locality or becomes a threat to public life (as in cases of man-eating tiger, rogue elephants, etc.). The Second Schedule gives a list of wild animals whose trophies, meat or skin cannot be possessed without a lawful certificate. The Third Schedule includes 18 reptiles, 461 birds, and 67 mammals which are protected and cannot be hunted, killed or captured. Under this schedule the killing of all game animals—when they are pregnant, or when in a condition that indicates they are suckling or feeding the young, or when accompanied by their immature offspring—is prohibited. This schedule also restricts the killing of all females listed in Part II of the First Schedule, except when a special permit has been issued—as in case of a man-eating tigress, rogue elephant, etc. Punishments have been prescribed under Article 26 of this Act. According to the nature of the crime punishments range from a minimum fine Tk.500, with or without 6 months imprisonment to a maximum fine of Tk.2000 with or without 2 years imprisonment. Islam (2004) did not consider the Act as all-encompassing; he commented that, worse still, the provisions included in the Act have not been properly implemented in the absence of adequate staff, facilities, funds etc. and emphasized the need for its immediate revision.

The Bangladesh Wildlife (Preservation) (Amendment) Act 1974 provides for the establishment of a Wildlife Advisory Board, which was set up in 1976 under the chairmanship of the Minister of Agriculture, and was supposed to approve important wildlife management decisions and directives. In the same year, a Wildlife Circle was established within the FD with specific responsibility for wildlife matters under the charge of a Conservator of Forests (CF) responsible directly to the Chief Conservator of Forests (CCF). A $13.3 million scheme, entitled ‘Development of Wildlife Management and Game Reserves’ was incorporated within the country’s first Five-Year Plan, but reduced to $92 000 in the subsequent Two-Year Approach Plan (Olivier 1979) and subsequently the Circle was abolished in June 1983, allegedly in the interest of economy.

After the independence, the first Bangladesh Forestry Conference was held in 1977 in Dhaka, signifying an awakening for national forestry and a growing concern for forests and various aspects of their management (Mustafa 2002). The first forest policy in the independent Bangladesh was announced in 1979 (Gazette Notification No. 1/For-1/77/345 dated July 8 1979). Even though this policy received considerable input from the discussions recorded at the first national

forestry conference (Pant 1990), it has been described as a two-page manifesto-type statement with obscure and generalized directions—mostly focusing on the reformation of forest department. Khan (2001) transcribed the policy's suggestions for a better understanding of its traditional colonial-industrial approach as "horizontal expansion of the forest area" under government control that was to be "carefully preserved and scientifically managed" by a (centralized) "cadre of forest officers", "setting up of new forest-based industries", "optimum extraction of forest produce", and protection of forests from the (so-called) "encroachers". On conservation, the policy only stated that "effective measures shall be taken to ensure conservation of the natural environment and wildlife and for utilizing the recreation potential of forests". Another significant statement was 'forests should be carefully preserved and scientifically managed for qualitative improvement', seemingly superficial without depicting any guidelines or mechanism for such management. This policy also uttered about mass participation in country-wide large scale plantation programs with a view to improve the tree wealth of the country. Although initially the target places for plantations were the public marginal lands like roadsides, sides of railway lines and institutional premises; the degraded forest lands were included finally.

In 1993, the 20-year Forestry Master Plan (GoB 1995) was prepared by the government with the assistance of ADB and UNDP. It was implemented in 1995 (Muhammed et al. 2005), emphasizing forest conservation and aimed to increase the country's land area under tree cover (Ali and Khan 2004). The Plan provides a framework for optimizing the forestry sector's ability to stabilize environmental conditions and assist economic and social development (Mustafa 2002). Three imperatives were identified:- sustainability, efficiency and people's participation (GoB 1994a); these accord with Agenda 21s forest principles adopted at the United Nations Conference on Environment and Development, held in Brazil in 1992 (Khan 2001).

3.2.3.1 The Forest Policy of 1994: Landmark in Conservation Policy

During the formulation process of the Forestry Master Plan, the experts felt the necessity of revising the existing 1979 forest policy in order to facilitate the effective execution of the proposed Master Plan (Chowdhury 2003). Accordingly, an amended forest policy was enacted in 1994 (Bangladesh Gazette, July 6 1995, pp. 241–244). This policy marks a major departure from the manifestly commercial considerations of the earlier policies (Khan 2001). In it, there is the provision for declaring the country's natural forests of hilly areas and catchments of the rivers as protected areas in order to preserve soil, water and biodiversity. An aim of the government in the policy is to keep 10 % of the national forests as protected area by the year 2015 (GoB 1994b); this expressed the Government's firm commitment to biodiversity conservation and ecosystem protection—with the provision for designating critical areas like steep hill slopes, vulnerable watersheds and wetlands as forests and managing them as protected areas. The policy seeks participation of

local people in forest protection, especially in curbing illegal occupation of forest lands, illicit felling of trees and hunting of wild animals; this contrasts with the historic dependence on a state coercive forces (Khan 2001) and explored a new strategy for the management of protected areas. An overall enunciation of the people's participation was given in the first statement to achieve the government's target to bring 20 % of land under forest cover; at the same time, had been iterated theme-wise (e.g., afforestation and restoration programs) in some other subsequent statements of the policy. Although a very little about community involvement, in case of plantation program only, was mentioned in the forest policy 1979, people's participation for forest protection was emphasized for the first ever time in the forest policy 1994. The issue of participation in overall forest management was a novel and important element in this policy and corresponds with the belief expressed by Janes (2008) recognizing a paradigm shift within forest policy as a requirement of the modern society. This policy also depicted taking up mass media campaigning to create massive awareness about forest protection that ultimately mean the people's involvement. This forest policy 1994 visualizes

- equitable distribution of benefits among the people, especially those whose livelihood depend on trees and forests;
- people's participation in forest management, and
- the incorporation of people's opinions and suggestions in the planning and decision-making process (Ali and Khan 2004).

The Brundtland Commission's Report recognized the necessity of such participation as "sustainable development requires a political system that secures effective citizen participation in decision making" (World Commission on Sustainable Development 1987, p. 65). It is, in fact, the strategy that the have-nots join in determining how information is shared, goals and policies are set, tax resources are allocated, programs are operated, and benefits like contracts and patronage, are parceled out (Arnstein 1969).

3.3 Co-management Approach in Protected Areas: Paradigm Shift Towards Social Conservation

Community participation is broadly considered as an important factor in nature conservation (Mannigel 2008), which becomes effective only if effective incentives are offered to and roles are clearly defined of the participants (Sawhney et al. 2007). Collaborative management, abbreviated as co-management is "a situation in which two or more social actors negotiate, define and guarantee amongst themselves a fair sharing of the management functions, entitlements and responsibilities for a given territory, area or set of natural resources" (Borrini-Feyerbund 1996). This approach to management has been a fundamental recommendation of the past two World Parks Congresses, and is actively advocated by the IUCN (Roy 2004). In Bangladesh, the co-management actors are the FD as the legal custodian of protected

areas and the local and national stakeholders. Of them, local stakeholders are basically the poor who depend on those forested areas for subsistence livelihoods. But the activities of other socially and economically powerful forest destroyers stand against the poor communities. As a result, to counter these divisive forces, an institutional structure with broad-based support and participation of people from various strata of the society is needed in order to contribute towards generating constructive activities of various social groups, lower inter-class tension and remove hostility (Nishorgo 2008). Such institutional structures were formed officially in the name of Co-management Council and Co-management Committee (CMC) for the five pilot sites, according to the proposition of NSP in 2006 (Bangladesh Gazette No. pabama/parisha-4/nishorgo-64/(part-4)/112 dated August 10 2006), with representation from civil society, local government, local residents and resource user groups, and other government agencies (Box 3.1). The Co-management Committee is primarily responsible for overall management of the protected area and its surrounding buffer zone extending 5 km from the boundary of the National Park/Game Reserve/Wildlife Sanctuary. The Committee can recruit some members of the community to patrol the forest on a regular basis and pay for the services rendered from its own funds. For the financial sustainability of the CMC, there is a provision of turning a portion of the income generated from eco-tourism and other revenue raising activities in the protected areas over to the committee. The responsibilities of both the Council and Committee, defined through the official gazette notification by the government are given in Box 3.2.

3.3.1 Nishorgo Support Project (NSP): Step Towards Co-management Initiatives

People living in and around the conservation areas of Bangladesh rely extensively on natural resources to meet their subsistence requirements like food, fuel wood, fodder, medicine, weaving and building materials, bush meat etc. (Mukul et al. 2007). Because the declaration of those forests as protected areas reduced their access to many of these uses, the FD thought of offering Alternative Income Generation (AIG) activities for the local communities forming Forest User Groups (FUG) with a view to supporting their livelihoods and thus reducing pressures on forests. In Bangladesh, people's participation in forest management actually started in 1979 as *Betagi-Pomora* Community Forestry Project on government owned denuded hilly forest land. Subsequently, a number of projects of participatory forestry had been executed under initiatives of the FD, viz., Community Forestry Project 1981–1988, Upazilla Afforestation and Nursery Development Project 1989–1996, Coastal Greenbelt Project 1995–2002, The Forestry Sector Project 1988–2004, Sundarbans Biodiversity Conservation Project 1999–2006 etc. (Huda 2008). In 2004, realizing the success of people-oriented programs as in social forestry in Bangladesh (Rana et al. 2007; Muhammed et al. 2005, 2008a, b), the FD launched a co-management program as Nishorgo Support Project (NSP) in

the country's protected areas with the financial assistance of USAID (Sharma et al. 2008). The project was already working at five initial pilot sites, viz., Lawachara National Park, Satchari National Park, Rema-Kalenga Wildlife Sanctuary, Chunati Wildlife Sanctuary and Teknaf Game Reserve. Taking into consideration the weakness of present forest management system and encouraging success of social forestry, NSP aims to develop collaboratively co-management agreements leading to measurable improvements in forest and resource conservation in pilot protected areas and their buffer zones with the six specific objectives (Nishorgo 2008) as stated in the section of conceptual framework.

Box 3.1 Structure of Co-management Council and Co-management Committee (GoB 2006)

Co-management Council:

- Member of the Parliament as advisor
- Upazila Nirbahi (Executive) Officer (UNO) as Chairperson
- Assistant Conservator of Forest (ACF) as Member Secretary—1
- Representative from the Forest Department (FD)—1
- Representative from local government—13 (1 being woman)
- Representative from resource user groups (poor stakeholders)—9
- Representative from local elites (teacher, physician, social worker, newsman, religious leader, freedom fighter)—68
- Representative from resource owning groups (owners of brickfields, sawmills, wood and furniture businessmen)—6
- Representative from ethnic minority group—3
- Representative from law enforcing agencies (police, BDR, Ansar and VDP)—1
- Representative from local youth groups—2
- Representative local NGOs—2–4
- Representative from major stakeholder groups (e.g., tea estate where ever applicable)—1
- Representative from other government institutions—4–6

The total number of members in the council shall be not more than 55, and at least 10 of the members shall be women. The members will be elected for 4 years and new council will be formed every 4 years through Annual General Meeting.

Co-management Committee:

- Upazila Nirbahi (Executive) Officer (UNO) as advisor
- Assistant Conservator of Forest (ACF) as Member Secretary—1
- Representative from the FD—1
- Representative from local Government (one being woman)—3–4
- Representative from civil society—2–3

- Representative from resource user groups—2
- Representative from local youth groups—1
- Representative from resource owning groups—2
- Representative from ethnic minority groups—2
- Representative from law enforcing agencies—1
- Representative from other government institutions—2
- Representative from NGOs—1

The total number of members in the committee shall be between 15 and 19. The committee will be formed amongst the members of Co-management Council and will be elected by the respective groups of the Council for 2 years.

The co-management approach is mainly centered on its local partners viewing them as the key stakeholders. Total population within the five pilot site landscapes of NSP is estimated just to over quarter of a million, of which, roughly 90 % are considered to be poor or ultra-poor (DeCosse 2006). Apart from the recognition of their resource use from forests for everyday utility, NSP developed a range of options and incentives in the name of AIG activities for those people aiming at regulating forest use. Different strategies have been used for the interior and exterior villages of the protected areas, since their needs and limitations are dissimilar (Mukul and Quazi 2007). The AIG activities are, in some cases, ethnicity-specific and vary region to region (DeCosse 2006).

Box 3.2 Job Responsibilities of Co-management Council and Committee (GoB 2006)

Co-management Council:

1. Convening an annual general meeting and at least one additional meeting
2. Providing pertinent suggestions to the Divisional Forest Officer (DFO) on any modification, addition or correction after reviewing the annual work-plan of the PA
3. Taking collective decisions on activities that have adverse effect on areas in and around PA
4. Providing required guidance to the Co-management Committee (CMC) on PA management
5. Developing policies for distribution of goods and services gained from PA among the stakeholders and also oversee such distribution among them by the CMC
6. Providing required approval to the PA Annual Work Plan developed by the CMC
7. Playing effective role in quelling any conflict that arises among the members of the CMC.

Co-management Committee:

1. CMC will act as executive body of the Council and will be accountable to the Council for all their activities
2. Liaising with FD officials responsible for management of the PA on local stakeholders' participation;
3. Distributing the proceeds from goods and services from the PA among the groups or teams linked with management activities according to the guideline developed by the Council
4. Supporting FD in employing labor from groups/teams linked with PA management in development activities undertaken by NSP
5. Developing and submitting project proposals requesting funds for development of the PA and landscape zone
6. Developing work plan for expenditure of fund collected locally through PA management and ensuring spending upon approval from respective DFO
7. Maintaining proper accounts of all local collection and expenditure from PA management.
8. Taking required steps, upon approval from the DFO, to initiate patrols for maintenance of PA resources
9. Playing supportive role in containing any conflict arising between local stakeholders and FD or any other government/non-government organizations.

3.3.2 Preliminary Results of NSP

The protected area system in Bangladesh has been proceeding gradually towards success for biodiversity conservation through the involvement of local communities in management activities. In general, the principal cause of forest loss in protected areas of Bangladesh is human-induced removal of woody biomass, in the form of timber and fuel wood. Against the interventions within the stipulated project period, the FD foresee a reduction in fuel wood removal and illegal logging, that will lead to a gradual re-establishment of forest habitats—especially natural generation of trees, shrubs and herb, and consequently support the biodiversity within the protected areas (Aziz et al. 2004). The authority's prediction is becoming true being manifested by the findings of a study conducted in Lawachara National Park. In 2004, the park was losing over 100 mature teak (*Tectona grandis*) trees every month by illegal felling, which has nearly been stopped presently, securing a safe dreamland for the hoolock gibbon (*Hoolock hoolock*) that needs closed canopy forest for the survival (Fig. 3.4) (Nishorgo 2007). Mukul

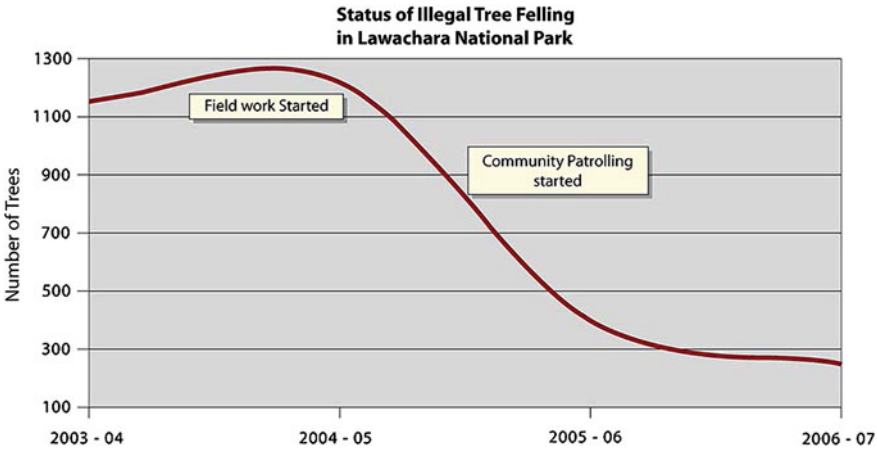

Fig. 3.4 Status of illegal tree felling in Lawachara National Park after implementing co-management (Nishorgo 2007)

and Quazi (2007) also found small but definite positive changes in the management of Satchari National Park with local people's participation and introduction of AIG activities for them. A majority of female members of the FUG left the profession of fuel wood collection after involvement in co-management activities in this protected area who feel that their participation in FUG helps increase their skills, decision-making power and respect in the eyes of the members of family and society (Subhani 2008). Nearly half of the women earn income independently in Lawachara National Park since their participation in co-management, who categorized 'saving money' and 'preserving biodiversity' as the top two reasons for joining FUG (Shewly 2008). Hoque (2008) revealed the improvement in socio-economic conditions of the FUG members after participation in co-management which made them socially empowered and more apt to interact with community members. Regarding the impact on biodiversity status, density (number/sq km) of both the red jungle fowl (*Gallus gallus*) and puff-throated babbler (*Pellorneum ruficeps*), two common bird species considered as the key biodiversity indicators in Bangladesh forests (Aziz et al. 2004), has been increased in 2006 with compared to that of 2005 in the entire five pilot PAs (Nishorgo 2007). All these findings reflect the worth of adopting co-management approach in protected area management. In general, the conflicts between local people and conservation arise from the former's dire necessity to satisfy basic needs and ignorance about the values of conservation of natural resources (Feeroz and Islam 1996). By the efforts of NSP, a greater understanding of the necessity for forest conservation to their own survival and to secure their future generations, combined with a viable means to earn a living, has motivated some people to change their mind and occupations from forest destroyers to tree growers and forest protectors (Mukul and Quazi 2007).

3.4 Discussion and Synthesis

Forest policy has been shifted from its traditional production approach for revenue collection to a participatory approach aiming for more effective forest management as envisaged in the latest 1994 forest policy. In accordance with the changing mandates of the forest policy from 'production forestry' to 'people- oriented forestry' over the last three decades, the activities of the FD have been expanded from the reserved forests to the village level.

Conservation of biodiversity through protected area management emerged only recently as a major concern of the FD. For the effective implementation of conservation, the Government of Bangladesh took several initiatives; the important one is instituting a reform in the organization of the FD in 2001 (Notification No. PaBaMa/Sha-2/Ban (Pra: Sa:)-22/98(6)/296, dated June 24 2001). A new Circle—the Wildlife and Nature Conservation Circle (WNCC) was established with sufficient staff to be responsible for the management of protected areas included in different Wildlife and Nature Conservation Divisions countrywide.

Bangladesh is high in biodiversity but, of course, this biodiversity is increasingly threatened with local extinctions likely to have occurred in the recent past (IRG 2004). The causes of biodiversity loss are many; almost all of which are linked to the immense biotic pressure which leads to the conversion of forest lands into agriculture, industries and settlement (Sharma et al. 2008). The protected area system, if well designed and managed, is intended to protect the majority of the country's biodiversity. Although such systems have already been implemented in pilot protected areas, still there remain drawbacks. Administrative boundaries between protected areas and other land uses create abrupt ecological transitions affecting both conservation priorities within protected areas and other priorities adjacent to them (e.g., Knight and Landres 1998), so buffer zones have been proposed as one way to ameliorate these effects (Heinen and Mehta 2000). Unlike Nepal (Mehta and Heinen 2001) and India (Shrivastava and Heinen 2007), neither the Bangladesh Wildlife (Preservation) (Amendment) Act 1974 nor the gazette notifications for the notified protected areas specify core areas and buffer zones (Sharma et al. 2008).

With the growing emphasis on the devolution of responsibility for management of forest resources to local communities, there is increasing realization of the importance of an appropriate policy and legal framework (Lindsay 1999). Many countries have put forward and adopted appropriate changes—India (Shrivastava and Heinen 2007), Nepal (Heinen and Mehta 2000), Brazil (Mannigel 2008), Cameroon (Tieguhong and Betti 2008), etc. The Forest Act 1927 and the Bangladesh Wildlife (Preservation) Order 1973 need to be updated immediately. In 1989 an amendment has been made in the Forest Act 1927 only with minor changes to the penalty provisions; despite the changes in the Act, Muhammed et al. (2008b) blamed the failure of enforcement and assessment of penalties as one of the most serious roadblocks to successful forest policy. On the other hand, already the FD has developed a proposed amended version of the Bangladesh

Wildlife (Preservation) Order to take into account a number of significant changes in the area of biodiversity management since the original Order was approved (Nishorgo 2008). The remarkable changes include the appointment of Chief Wildlife Warden, detail constitution of the Wildlife Advisory Board with a significant number of members including the relevant ministries, provision for the determination of threatened species of wild animals and plants, granting permit to collect and utilize wild animals and plants for special purposes such as education, scientific research, scientific management etc. Chapter 4 of the draft amended Order deals with the matters of protected areas where a number of new important sections have been added—emphasis on co-management for protection, improved management and sustainable use of wildlife resources and habitats with sharing of cash and in-kind income from the protected areas; provision of declaring community conservation area, landscape zone, safari park, eco-park and botanical gardens after having consultation with the local community; granting permit to enter or reside in protected areas for the purposes of study, photography, scientific research, eco-tourism etc.; stipulation of the government's responsibility to issue an annual report on the state of the protected areas with the updates of the status and conservation trends, making which available to the general public; and to maintain dialogue with other countries along international boundaries on collaborative conservation. All these changes in the draft amendment gave a picture of the authority's positive attitudes towards and rigid responsibility of biodiversity conservation.

MacKinnon et al. (1986) commented that if protected areas are to be effective in conserving biodiversity, the protected area system must be representative of all ecosystem types. Although Bangladesh's protected areas represent three major forest types: hill forests, Sal forests and mangrove forests; there is little representation of the Chittagong Hill Tracts (CHT) despite it constituting 76 % of the country's total hilly area (Khisa 1997), supports 1.32 million ha forests covering 9.1 % of the country's total area (Ahmed 1999) and is prone to depletion and degradation in volume, area and quantity (Salam et al. 1999). This may, in part, be due to the unrest situation arising from the insurgency movement of its tribal inhabitants. During British colonial rule and in united Pakistan, the CHT tribe people remained silent, despite their exploitation; the insurgency movement really began after the independence of Bangladesh. Although the government of Bangladesh signed a peace accord with the insurgents in 1997, the CHT still remains in turmoil (Islam 2003). However, after resolving the existing conflicts, it seems coherent making attempts to declare more parts from the CHT as protected areas for ensuring its proper representation from the viewpoints of its uniqueness in topography and biodiversity, and also the forest type. It has already been mentioned before only a little (5 %) of the hill forests is protected in comparison to sal forests (11 %) and mangrove forests (23 %) while the total area of the former (0.67 million ha) is more than that of the latter two (0.12 million ha and 0.60 million ha, respectively) (BFD 2008). Another key ecosystem of the country, the freshwater wetland ecosystem, most of which is belonged to the fresh water swamp forest, remains left out from protected areas, and therefore, needed to be included.

Choudhury (2002) reported that the effectiveness of Bangladesh's protected areas is also limited because they are portions of reserved forests which have, in most cases, only been declared as such after being degraded heavily by illegal logging, land clearing, burning, and poaching. Moreover, corruption in forestry sector also hampers the implementation of conservation strategies properly. TIB (2000) reported the cutting and selling of trees by timber traders and smugglers, and killing of animals by poachers with the direct cooperation of forest officials through bribery and other illegal means such as embezzlement and misuse of power. The uneven distribution of AIG support among the co-management partners—focusing heavily on a small number of high-interest groups—as was reported by Mukul and Quazi (2007), depicts another dimension of corruption which may hamper achieving goals of co-management initiatives. The respective authority should address this issue acutely to ensure the real representation of the key stakeholders of the local communities. Thus, a better coordination between the FD and intended beneficiaries is to be insisted and an activity of uninterrupted monitoring should be promoted.

Bangladesh expressed its commitment towards international treaties and conventions by signing and ratifying 27 international conventions and protocols related to biodiversity, environment, and development. Bangladesh is one of the signatories of the United Nations Framework Convention on Climate Change (UNFCCC), Kyoto Protocol, Convention on Biological Diversity (CBD), Global Tiger Forum (GTF), International Convention to Combat Desertification, Convention on International Trade in Endangered Species of Wild Fauna and Flora-CITES; ratified the Ramsar Convention, World Heritage Convention and other important treaties. Since signing the CBD in 1992, biodiversity issues have received some attention in a variety of sector policy and strategy documents. In a related development in the ratification of the World Heritage Convention, parts of the Sundarbans mangrove forest have been declared as a World Heritage Site. Furthermore, to implement the recommendations of Agenda 21 and address its environmental problems, the country developed the National Environmental Management Action Plan-NEMAP in 1996—a product of the participatory process led by NGOs with involvement of grassroots people. To comply with the requirement of CBD, in 2004 Bangladesh has prepared the National Biodiversity Strategy and Action Plan (NBSAP). The NGO involvement in biodiversity conservation in Bangladesh is emphasized by the FD with its Nishorgo Support Project implemented by International Resources Groups (IRG) of USA in association with the national NGO partners—Community Development Center Chittagong (CODEC), Nature Conservation and Management (NACOM) and Rangpur Dinajpur Rural Services (RDRS) (Nishorgo 2008), although the NGO involvement in biodiversity conservation was initiated previously in several other projects of the FD. However, in spite of all these attempts, there are still some issues that the protected area system of Bangladesh must consider and implement to achieve its overall goals of biodiversity conservation:

- creation, demarcation and management of buffer zones as an alternative resource exploitation zone to protected areas;
- fixation of allowable resource extraction limits from protected areas;
- gradual adoption of co-management approach in all the protected areas;
- strengthening public-private partnership for integrated management;
- setting up a separate protected areas and biodiversity management wing in the FD;
- formulation of separate wildlife and protected area policy as in Sri Lanka;
- approval of the proposed amendments in Bangladesh Wildlife (Preservation) Order 1973; and
- taking trans-boundary initiatives with India for the protected areas in the Sundarbans mangrove forest as in Nepal with India and China.

3.5 Conclusion

There is a dilatory change in the forest policy of Bangladesh and a paradigm shift from traditional production doctrines towards participatory protection principles over the last three decades. In the state of continuous degradation of the country's forest resources due to multi-dimensional pressures, biodiversity conservation became a major concern to the policy makers. Therefore, parts of forestlands in all the four forest types have been declared as protected areas in correspondence with the IUCN category. The protected area system has been strengthened with the adoption of co-management approach involving the local communities by the recognition of their usufruct rights over forest resources. The government's contemporary, cautious initiative of AIG support motivated the local users to cooperate with the Forest Department in carrying out management activities and, at the same time, reducing the pressures on protected areas. With the reduction of corruption and the exercise of the officials' egalitarian view to every participant, the co-management approach needs to be replicated from the pilot sites to other protected areas of the country. A clear demarcation of core area and buffer zone should avoid the uncontrolled resource exploitation by the co-management beneficiaries.

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Chapter 4
Local Communities' Use of Biomass Fuels and Attitude Towards Improved Cooking Stoves in and Around Rema-Kalenga Wildlife Sanctuary

Mohammad Shaheed Hossain Chowdhury, Masao Koike and Shigeyuki Izumiyama

Abstract Use of biomass fuel in traditional cooking stove (TCS) is the long-established practice that exhibits incomplete combustion and generates substances with global warming potential (GWP). Improved cooking stove (ICS) has been developed worldwide as an alternative household fuel burning device, a climate change mitigation strategy as well. A study was conducted in the female Forest User Groups (FUGs) of Rema-Kalenga Wildlife Sanctuary, Bangladesh to assess the status of ICS disseminated by the Forest Department (FD) under Nishorgo Support Project along with the community's biomass fuel consumption pattern. Consumption of wood fuel was highest (345 kg month^{-1} household^{-1}) followed by agricultural residues (60 kg month^{-1} household^{-1}), tree-leaves (51 kg month^{-1} household^{-1}) and cow-dung (25 kg month^{-1} household^{-1}). Neighboring forest of the sanctuary was revealed as the core source for wood fuel with little or no reduction in the extraction even after joining the FUG. Twenty two species, both indigenous and introduced, were found in preference for wood fuel by the community. None of the respondents were found willing to use ICS although 43 % of them owned it; either as the status symbol or to meet the condition of the FD to continue membership in FUG. Seven negative features of the disseminated ICS were identified by the households that made them unwilling to use it further. Manufacturing faults may be responsible for the ICS's demerits and FD's negligence was liable to the failure of convincing the community. A proper examination

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M. S. H. Chowdhury (ed.), *Forest Conservation in Protected Areas of Bangladesh*, World Forests 20, DOI: 10.1007/978-3-319-08147-2_4,

of the disseminated ICS's efficacy is crucial with active involvement of the community members. The Sustainable Energy Triangle Strategy (SETS) could be implemented for this purpose. Findings of the study would be of immense importance in designing the strategy for the introduction of ICS in Bangladesh.

4.1 Introduction

The energy-poor people, having no access to modern energy services constitute about 30 % of the world's total population. The situation remains more vulnerable in developing countries where nearly two out of five people are under energy-poverty (Birol 2007). It entails these people rely on biomass fuels such as woods, branches, agricultural residues and animal (cattle) dung to meet all their cooking and heating energy needs. Currently, 2.5 billion people—40 % of the world's population—rely on such traditional fuels (Birol 2007). Biomass energy accounts for about 14 % of the primary energy consumption in the world and about 38 % in developing countries (Raghuvanshi et al. 2008), where household energy consumption is mostly used for cooking and constitutes around half of the total energy use in household (Miah et al. 2010). In a recent estimate, FAO (2010) reported that production and consumption of wood fuel is highest in Asia followed by Africa and Latin America, where most of the world's poor people live. Jankes and Milovanovic (2001) reported about the common usage of biomass in low capacity boilers or furnaces, local household cooking or farm heating, which is the simplest and cheapest way. The combustion process in such traditional devices is non-ideal and favoring incomplete combustion (Panwar et al. 2009) that leads to the formation of pollutants such as carbon monoxide (CO), nitrogen oxides (NO_x), aldehydes, polycyclic aromatic hydrocarbons (PAHs) and primary and secondary particles (Bhattacharya et al. 2000; Miah et al. 2009). The use of biomass fuels contributes 1–5 % of all CH_4 emissions, 6–14 % of all CO emissions, 8–24 % of all total non-methane organic compounds (TNMOC) emissions and thus 1–3 % of all human induced global warming (Smith 1994).

Traditional cooking stove (TCS) is the most commonly used device for cooking in rural communities worldwide that generally burns biomass fuels with an efficiency of roughly under 10 % (Geller 1980), generating considerable quantities of products of incomplete combustion (PIC) and causing significant levels of indoor air pollution (Smith et al. 2000; Parikh et al. 2001). Along with the CO_2, the PICs have substantial global warming potential (GWP) as well as detrimental effects to the human health (Panwar et al. 2009). Referring from the estimate of World Health Organization (WHO), Moore (2009) reported that TCS are linked to 1.6 million deaths per year from indoor air pollution. Moreover, they are linked to unsustainable harvesting of fuel wood from forests causing rapid deforestation and consequently a change in the ecosystem, leading to soil erosion and change in the climatic pattern (Hossain 2003). Therefore, improved cooking stove (ICS) has

been emerged as an alternative fuel efficient cooking device in rural communities of many developing countries in Asia, Africa and Latin America (Westhoff and Germann 1995). On an average, an ICS is in position to save 700 kg of fuel wood per year (Kishore and Ramana, 2002) and about 161 kg of CO_2 annually (Panwar et al. 2009).

Bangladesh, with a total land area of 147,570 km^2 and a population of 156 million possesses 2.52 million ha forest land (17.08 % of the total land with actual vegetation coverage of 6.7 %) (FAO 2010). There are 20 protected areas covering almost 2 % of the country's total area and 11 % of the total forest area (BFD 2008). The estimated total biomass in Bangladesh is 63 million tones (72 t/ha) and total carbon in biomass 31 million t (36 t/ha) with a total growing stock of 30 million m^3 (34 m^3/ha) (FAO 2010). Shin et al. (2007) revealed that on an average, 92 tC/ha is stored by the existing tree tissue in the forests of the country. Bangladesh's protected areas are in the interspersion of human habitation since long and the local communities are extremely dependent on them for livelihoods. Among the dependencies, fuel wood collection for everyday cooking constitutes the major exploitation activity, the unsustainable harvesting of which is shrinking the forest, the carbon stocks. FAO (2010) assessed the annual rate of deforestation as 2,000 ha, or 0.3 % in the period of 2000–2005 over the whole country. To check such degradation, especially in protected areas, the government introduced an alternative strategy of co-management involving the local communities with a provision of incentives in terms of Alternative Income Generation (AIG) supports under a donor assisted project (Chowdhury et al. 2009). It was started with the name Nishorgo Support Project (NSP) and was implemented in five protected areas as pilot project in 2004. A total of 19 various AIG activities have been introduced by NSP and ICS is one of them, which is claimed to save 50–70 % fuel as compared to the traditional ones (Islam et al. 2006). It has been disseminated to the Forest User Groups (FUGs) with a view to reducing pressure on forest by cutting less trees, releasing less carbon in the atmosphere and thus mitigating climate change in micro-site level. This section discusses the mode and pattern of using various biomass fuels by the rural communities living in and around Rema-Kalenga Wildlife Sanctuary highlighting the exploration of the status of ICS program and local communities' perception about it. Apart from the analysis based on overall sample size, special emphasis was given to the female groups.

The female FUGs were selected purposively as elsewhere women are the ones, responsible for cooking and feeding other members of the family. By tradition, cooking is exclusively done by women and cooking along with responsibility to other family members occupies a major portion (51–54 %) of a woman's daily life in Bangladesh (Alam et al. 2006). In doing so, the rural women play a significant role in procuring and processing fuel for domestic energy generation (Pal and Sethi 2005). A total of 370 female members in 30 groups are there in RKWS. Under the AIG activities, the NSP provided training to 20 selected women on the manufacturing of ICS, with a condition for transferring the technology to others in the study area with a minimum cost of Taka 450 each (Taka 70 = US$1). From the total members of the female FUGs, we selected 70 individuals randomly for

the study including both the users and non-users of ICS. In addition, one focus group discussion was arranged in the yard of a member's home to know the overall community perception. After collecting data, the respondents were categorized into three groups with respect to housing status as the owner of tin-shed bamboo fenced house, thatching grass and bamboo fenced and thatching grass and mud-walled house. Since cooking stove-related various parameters (viz., indoor air quality, fire hazards etc.) are linked to the structure and material of housing, the respondents were categorized accordingly.

4.2 The Cooking Stove Types

Two types of cooking stoves—traditional cooking stove (TCS) and improved cooking stove (ICS) were found in the study area. The majority of the respondents (71.5 %) were found to have the TCS only; a very negligible proportion (1.3 %) ICS only, while the remaining (27.2 %) both the TCS and ICS together. No household having the "ICS only" was found in the categories of inside villages, medium stake and minor stake villages, and female groups (Table 4.1). When considered the female respondents only, it was seen that all the respondents, irrespective of housing status owned the TCS whereas only 43 % owned the ICS along with the TCS. But interestingly, none of them were found to use the ICS presently (Table 4.2).

4.2.1 Traditional Cooking Stove

This is usually a mud-built device with three raised points on which the cooking pot rests. One opening between these raised points is used as the fuel-feeding port and the other two for flue gas exit. In some cases, two potholes are joined together and a single fuel-feeding port is made for common use. In the study area, the TCS are built with such dimensions as: average diameter of fuel-feeding port 24 cm, average diameter of pothole 23 cm, average depth, i.e., distance between the pot and fuel bed 60 cm and average height of the cones (raised points) of potholes 30 cm. This may be built under- or above-ground and both types were seen in the study area.

4.2.2 Improved Cooking Stove

This is an upgraded and modified version of a TCS developed by the NSP in collaboration with an NGO and the technology is transferred to the FUGs through intensive training. It has two chambers. In the first chamber fuel is burnt and

Table 4.1 Type of cooking stove owned by the local community in and around Rema-Kalenga Wildlife Sanctuary

Category		Relative frequency of reporting by respondents (%)		
		TCS only	ICS only	Both
Overall		71.5	1.3	27.2
Village position	Inside	88.9	–	11.1
	Adjacent	67.9	1.2	30.9
	Outside	73.8	1.6	24.6
Village stake	Major	64.6	1.6	33.9
	Medium	78.4	–	21.6
	Minor-medium	69.4	2.8	27.8
	Minor	100	–	–
Ethnicity	*Bangalee*	68.4	1.2	30.3
	Tribe	84.5	1.7	13.8
Gender	Male	77.6	1.7	20.7
	Female	57.1	–	48.6

Table 4.2 Type of cooking stove owned and used by the female respondents

Parameters	Type of cooking stove	Overall frequency (%)	Frequency with respect to housing status (%)		
			Tin-shed bamboo fenced	Thatching grass bamboo fenced	Thatching grass mud walled
Cooking stove owned	TCS only	57.1	–	66.7	63.2
	Both TCS and ICS	42.9	100	33.3	36.8
Cooking stove presently used	TCS only	100	100	100	100
	Both TCS and ICS	–	–	–	–

cooking takes place through the direct heat from the fire. The combustion products from the first chamber enter the second chamber on the right through a space and provide heat for cooking in the right chamber. Later the smoke is carried away from the chambers by a chimney. The chimney is built either with PVC (polyvinyl chloride) pipe or simply mud. There are no raised points at the potholes like the TCS. In the study area, the ICS are built with such dimensions as: average diameter of fuel-feeding port 20 cm, average diameter of pothole 18 cm, average depth, i.e., distance between the pot and fuel bed 40 cm, average length of the chimney 180 cm with an average diameter of 8 cm having 3–4 perforations at top with average diameter of 1–2 cm. This is built above-ground only. Figure 4.1 shows the pictures of TCS and ICS available in the study area.

Fig. 4.1 Traditional and improved cooking stoves in the study area

4.3 Fuel Consumption Pattern

The respondents were reported to exclusively be dependent on biomass fuels for household uses. Four different kinds of biomass fuel such as wood and branches, cow-dung, agricultural residues and tree-leaves were found in use for household utilities like cooking, paddy parboiling, water heating, and preparing cattle feeds etc. (Fig. 4.2). It was revealed that only wood was used by most of the respondents (71.4 %) while the other fuels were used in varying intensities along with wood (Fig. 4.3).

It was found that, on an average, 276 kg of fuel wood was consumed by the respondents; the highest consumption was found among the female (Table 4.3). The significant difference on the consumption of fuel wood was observed among the respondents on the basis of ethnicity only. For more specific idea regarding biomass fuel use, when the female respondents were asked for in-depth information, it was revealed that consumption of agricultural residues ranked second highest (60 kg month^{-1} household^{-1}; SE 9.92), followed by tree-leaves (51 kg month^{-1} household^{-1}; SE 0.67) and cow-dung (25 kg month^{-1} household^{-1}; SE 5.00). There was a significant difference in the average monthly consumption of wood fuel among the household categories based on housing status at the $p < 0.05$ significant level (Table 4.4). Respondents with thatching grass and mud-walled houses had higher average monthly consumption of wood than the respondents of other two categories. Use of cow-dung and tree-leaves was not found in the respondents with housing status of tin-shed bamboo fenced and thatching grass and bamboo fenced categories.

Four different sources of biomass fuel (Table 4.5) were identified in the study area as forest only, homesteads only, forest and homestead, and forest, homestead and market. Overall, 'forest and homestead' constituted the major source (52.6 %) followed by 'forest' (34.8 %), 'homestead only' (7.9 %) and 'forest, homestead and market' (4.6 %). The situation was severe in the case of female groups; according to them, solely the forest constituted the major source (57 %) from where all the three sub-categories collected wood fuel. Only half of the female

Fig. 4.2 Various kinds of biomass fuel: wood, agro-residue, cow-dung and tree-leaf (*clockwise* from above)

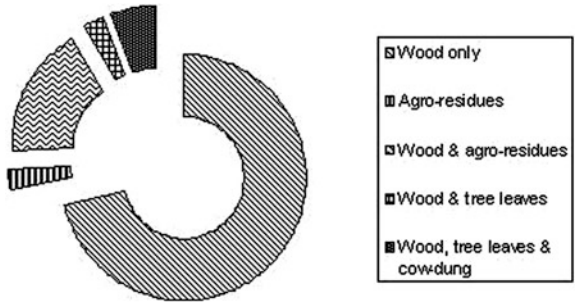

Fig. 4.3 Various biomass fuel used in the study area

respondents with tin-shed bamboo fenced houses buy wood fuel from market. Females were reported as the predominant collectors of fuel wood from forest (61 %) followed by the males (27.4 %) and children (11.6 %). Females were found to play the major role in procuring the fuel from homesteads also, where children assist them and the males' part is negligible (Table 4.6).

During the study, the respondents were asked a specific question "Is there any reduction in wood fuel collection from the forest after joining the FUG?" In response to it, most of the respondents (61.9 %) opined that there was a reduction

Table 4.3 Average monthly consumption of biomass fuel (fuel wood only) by the local communities in and around Rema-Kalenga Wildlife Sanctuary

Category		Amount consumed (kg month^{-1} household^{-1})
Overall		276.18 (SE, 10.21)
Village position	Inside	194.44 (SE, 14.82)[a]
	Adjacent	280.03 (SE, 12.16)[a]
	Outside	283.11 (SE, 19.17)[a]
Village stake	Major	284.09 (SE, 15.01)[a]
	Medium	277.39 (SE, 19.66)[a]
	Minor-medium	274.38 (SE, 23.44)[a]
	Minor	210.67 (SE, 11.48)[a]
Ethnicity	Bangalee	289.86 (SE, 12.26)[a]
	Tribe	218.62 (SE, 9.83)[b]
Gender	Male	266.85 (SE, 12.50)[a]
	Female	344.57 (SE, 25.07)[a]

Values in parentheses indicate standard error
[a–c] indicate that values are significantly different at the $p<0.05$ significant level

Table 4.4 Average monthly consumption of various biomass fuels by the female respondents

Fuel type	Quantity used (kg month^{-1} household^{-1})			
	Overall	Tin-shed bamboo fenced	Thatching grass bamboo fenced	Thatching grass mud walled
Wood	344.57 (25.07)	255 (28.72)[a]	275 (27.84)[b]	407.37 (37.09)[c]
Agro-residues	60 (9.92)	65 (10)	57.50 (14.93)	–
Tree leaves	50.67 (0.67)	–	–	50.67 (0.67)
Cow-dung	25 (5.00)	–	–	25 (5.00)

Values in parentheses indicate standard error
[a–c] indicate that values are significantly different at the $p < 0.05$ significant level

in the collection of fuel wood from the sanctuary after their joining the FUG. Divergence in the response was seen according to the categories (Table 4.7). When considered the female category, all the respondents with tin-shed bamboo fenced houses reported the positive answer while most of the respondents of the other two categories reported the negative answer and few of them did not agree to make any comment (Table 4.8).

4.3.1 Species Preference for Biomass Fuel

Although various parts of different species were used as fuel in the study area, a total of 22 tree and shrub species were found to be preferred as fuel by the respondents. Five species, viz., *Acacia auriculaeformis*, *Acacia mangium*, *Albizia saman*, *Albizia* spp., and *Syzygium* spp. had the high preference level while *Alstonia scholaris* had the low preference (Table 4.9). About 77 % of these species

Table 4.5 Source of fuel wood used by the local communities

Category		Sources (%)			
		Forest only	Homestead only	Forest and homestead	Forest, homestead and market
Overall		34.8	7.9	52.6	4.6
Village position	Inside	72.2	–	27.8	–
	Adjacent	32.1	8.0	56.2	3.7
	Outside	32.8	9.0	51.6	6.6
Village stake	Major	31.5	9.4	55.1	3.9
	Medium	38.6	4.5	52.3	4.5
	Minor-medium	33.3	11.1	48.6	6.9
	Minor	46.7	–	53.3	–
Ethnicity	Bangalee	31.1	9.4	53.7	5.7
	Tribe	50.0	1.7	48.3	–
Gender	Male	31.5	7.8	59.1	1.7
	Female	57.2	5.7	31.4	5.7

Table 4.6 Source of fuel wood according to the female respondents

Source of fuel wood	Overall frequency (%)	Frequency with respect to housing status		
		Tin-shed bamboo fenced	Thatching grass bamboo fenced	Thatching grass mud walled
Forest only	57.2	–	58.3	68.4
Homestead only	5.7	–	16.7	–
Forest and homestead	31.4	50.0	25.0	31.6
Forest, homestead and market	5.7	50.0	–	–

Table 4.7 Reduction in the collection of fuel wood after joining the FUG

Category		Relative frequency (%)		
		Yes	No	No comments
Overall		61.9	35.8	2.3
Village position	Inside	44.4	55.6	–
	Adjacent	63.6	35.8	0.6
	Outside	62.3	32.8	4.9
Village stake	Major	63.8	35.4	0.8
	Medium	58.0	37.5	4.5
	Minor-medium	65.3	31.9	2.8
	Minor	53.3	46.7	–
Ethnicity	Bangalee	66.8	30.3	2.9
	Tribe	41.4	58.6	–
Gender	Male	65.1	31.9	3.0
	Female	51.4	48.6	–

Table 4.8 Reduction in fuel wood collection from the sanctuary after joining the FUG (female respondents only)

Response	With response to housing status (%)			
	Overall	Tin-shed bamboo fenced	Thatching grass bamboo fenced	Thatching grass mud walled
Yes	51.4	100	25.0	26.32
No	48.6	–	67.67	63.16
No comments	–	–	8.33	10.52

are indigenous and the remaining 23 % are exotic in the study area and were introduced as plantation by the Forest Department in the vacant and degraded sites of the protected area.

4.4 Status of ICS and the Community Attitude Towards Them

From the survey, particularly among the female members of the FUGs, it was revealed that about 43 % respondents owned the ICS but nobody was using it. To explore the present condition of these ICS, question was asked to them and physical observation was made to their houses. Half of the women in both the categories with tin-shed bamboo fenced house and thatching grass roofed bamboo fenced house kept the ICS as it is in their cooking place and the remaining half broke it with rage. About 86 % of the respondents in third category kept it as it is and the remaining broke with rage. In response to the question on the willingness to use ICS, about 86 % of the respondents, irrespective of housing category, strongly opposed to use it, while the remaining did not want to make any comment. The category-wise responses are shown in Table 4.10.

A total of seven reasons for the respondents' denial to use ICS were reported in the study area (Table 4.11). All of these reasons are either the demerits of using ICS or the indirect impact on other activities because of its use. Since women are the only ones whose responsibility is cooking and feeding the other members of the family, it is their duty to deal with the cooking stoves. In doing so, they are well acquainted with the benefits and/or troubles of the cooking devices too. Therefore, this specific question regarding the reason for the denial of ICS was asked to them. According to the respondents, the disseminated ICS produces more smokes, creates fire hazards, demands continuous supervision during cooking, needs straight and uniform sized fuel wood sticks, curtails time from other household activities, unable to use tree leaves and agricultural residues, and overall it exerts complexity in set up. Among the seven reasons, most of the respondents (74.3 %) reported about the complexity in set up.

Table 4.9 Species preferred for fuel wood by the local communities

Botanical name	Local name	Parts used	Preference level[a]	Occurrence level	Status	
					Exotic (22.73 %)	Indigenous (77.27 %)
Acacia auriculaeformis	Akashi	L, B, W	+++	+++	√	–
Acacia mangium	Mangium	L, B, W	+++	+++	√	–
Albizia saman	Raintree	L, B, W	+++	++	–	√
Albizia spp.	Koroi	L, B, W	+++	+++	–	√
Syzygium spp.	Jam	L, B, W	+++	+++	–	√
Aphanamixis polystachya	Pitraj	B, W	++	+++	–	√
Artocarpus heterophyllus	Kathal	L, B	++	++	–	√
Artocarpus chaplasha	Chapalish	B, W, R	++	+++	–	√
Artocarpus lakoocha	Dewa	B, W	++	+	–	√
Bambusa spp.	Bansh	L, T	++	++	–	√
Bombax ceiba	Shimul	L, B, W, R	++	++	–	√
Eucalyptus camaldulensis	Eucalyptus	L, B, W	++	++	√	–
Gmelina arborea	Gamar	B, W	++	+++	–	√
Lagerstroemia speciosa	Jarul	B, W	++	++	–	√
Litsea monopetala	Menda	L, B	++	++	–	√
Michelia champaca	Champa	B, W	++	++	–	√
Psidium guajava	Peyara	L, B	++	++	–	√
Switenia macrophylla	Mehogoni	L, B, W	++	++	√	–
Tectona grandis	Shegun	B, W, R	++	++	√	–
Terminalia arjuna	Arjun	L, B	++	+++	–	√
Toona ciliata	Toon/ Kuma	B, W	++	+	–	√
Alstonia scholaris	Chatim	L, B, W	+	++	–	√

L leaves, *B* branches, *W* wood, *T* twigs, *R* root, *P* petiole

[a] Ranked by FUG members in FGD as: +++ high; ++ moderate, and + low

√ indicates whether the respective species is exotic or indigenous

4.5 Discussion

Biomass resources are potentially the world's largest and sustainable energy source, a renewable resource comprising 220 billion oven dry tons of annual primary production (Turker and Kaygusuz 2001). It is normally the main source of energy in the domestic sector of developing countries. 84 % of the rural households in India (NSSO 2005), 89 % in Kenya (Theuri 2003), and almost all the households in Xian city, China (Tonooka et al. 2006) rely on it as their primary

Table 4.10 Status of ICS in the respondents' house in Rema-Kalenga Wildlife Sanctuary

Parameters		With respect to housing status (%)		
		Tin-shed bamboo fenced	Thatching grass bamboo fenced	Thatching grass mud walled
Present status	Kept as it is	50	50	85.7
	Broken with anger	50	50	14.3
Willingness to use ICS	No	100	91.7	78.9
	No comment	–	8.3	21.1

Table 4.11 Reasons for denial of using ICS by the local communities

Reasons for denial of using ICS	Overall (%)[a]	With respect to housing status (%)		
		Tin-shed bamboo fenced	Thatching grass bamboo fenced	Thatching grass mud walled
Produces more smokes	60	100	50	57.89
Creates fire hazards	54.3	50	66.67	47.37
Demands continuous supervision	57.1	100	33.33	63.16
Needs straight and uniform sized fuel wood sticks	62.9	100	50	63.16
Curtails time from other household activities	51.4	100	33.33	52.63
Can't use tree leaves and agro-residues	31.4	50	41.67	21.05
Complexity in set up	74.3	100	83.33	63.16

[a] Overall percentage is more than 100, because multiple reasons were reported by each respondent

cooking fuel. Traditional biomass fuels supply the major energy needs in rural areas of Bangladesh, constituting 73 % of the country's total energy consumption (Miah et al. 2010); the domestic sector's biomass consumption is 42 % of the total energy consumed (Hossain 2003). Like other rural communities of the world, all the respondents in the study area were found dependent on biomass fuels for everyday household uses. Most of them collected the wood fuel from forests while the others from homesteads and market. Miah et al. (2010) reported about the 56 % households' collection of biomass fuel from their own homesteads and/or agricultural lands in some of the disregarded villages of Chittagong, Bangladesh. Batliwala and Reddy (2003) informed about the use of inanimate energy in the village of Pura at Karnataka State of southern India, 97 % of which come from fuel wood and only about 4 % of which is purchased as a commodity, the remainder being gathered at zero private cost. In the study area, a considerable portion of the respondents (50 %) were found to buy wood fuel from the local market but it is confined only to the category with tin-shed bamboo fenced houses

indicating their well-off position among the respondents. Turker and Kaygusuz (2001) recognized fuel wood as a tradable commodity since long in the rural and sub-urban communities but on the contrary, Hillring (2006) assessed that internationally trade in wood fuel is rather new and not as established as for round wood or sawn wood.

The involvement of female members of the family in procuring biomass fuel is much higher than the male counterparts in the study area. It denotes their responsibility to cook and prepare foods for other members as is common in most of the rural communities worldwide. In these communities, the men in the family make decisions regarding all financial matters such as construction or renovation of kitchen, installing of new devices such as ICS etc., while women are responsible for positioning the cook stove in the kitchen, collection and selection of fuel wood species for use, cutting it in small pieces and storing etc. (Malhotra 1998).

The purpose of forming FUGs in pilot protected area sites in Bangladesh was to provide the selected members of deprived sections of the community with trainings on various AIG activities so that pressure on forests would be reduced by diverting them to alternative livelihoods. To what extent did this purpose work? From the opinion of respondents it was seen that reduction in fuel wood collection from forest occurred only in the category with tin-shed bamboo fenced house and no reduction in the other two categories. The latter categories are less well-off than the former one and have less plant resources in homesteads to use as fuel that may drive them continue collection from forests.

Like any other necessary commodity, demand for timber and wood products is connected to dense and fast growing populations. The situation of Bangladesh seems severe with a high population density (1,198/km^2) and annual growth rate (1.8 %), where rural people constitutes 74.5 % of the total population and forest area per 1,000 people is only 6 ha (FAO 2010). In addition, about 90 % of all families in the country use TCS for cooking and other heating purposes (Hossain 2003) indicating an extreme pressure on biomass fuels. Since wood fuel gathering was thought to be the primary cause of deforestation in such agrarian society, ICS have been long known as a major imperative for reducing deforestation (Karekezi and Turyareeba 2009). Miah et al. (2010) also urged on the reduction in the present exploitation rates of biomass fuel use in Bangladesh for checking deforestation and reducing environmental degradation. ICS saves 50–65 % fuel and cooking time compared with TCS and the maximum overall efficiency is estimated at 30 % (Alam et al. 2006). In that sense, introduction of ICS in the local communities in and around protected areas of Bangladesh was appropriate and time demanding decision. But the efficacy of the program is questionable and needs proper evaluation. In fact, it is important that new technologies or policies favoring changes in rural energy use patterns should be fully evaluated with respect to all major impacts of their use, positive or negative, at the outset (Edwards et al. 2004). In that perspective, the present study is a very little initiative in Bangladesh being conducted with the ICS program of NSP in Rema-Kalenga Wildlife Sanctuary where the program seems to be unsuccessful.

A wide variety of improved stoves have been developed and disseminated throughout Asia, Africa and Latin America (Westhoff and Germann 1995). A very few of them was ended with success story; most of them remained unsuccessful. The programs initiated by the government of India to improve the stove's efficiency and disseminate improved models showed negligible impact and therefore, TCS still predominates in rural Haryana (Joon et al. 2009). In Thailand, ICS has been developed and implemented by the government since 1984, but the project still has failed (Limmeechokchai and Chawana 2007). In Bangladesh, many of the ex-users of ICS were unconvinced of its advantages in southwestern rural areas (Alam et al. 2006). On the other hand, China's dissemination of ICS remains the most successful such program worldwide (Edwards et al. 2004). In our study area, the ICS program failed to convince the users who experienced a total of seven demerits of this stove. Every respondent reported multiple negative features and thereby each feature was overlapped every time with each single interviewee. For instance, producing more smokes and creating fire hazards were reported by 60 and 54.3 % of the respondents respectively. Although the ICS is to produce less smoke with zero fire hazard, as always claimed by its developers, the respondents experienced both of these features in the study area with the ICS disseminated by NSP. They commented, due to the lack of proper chimney outlet, the smoke is unable to escape into the atmosphere and becomes trapped inside. It was seen that, all the demerits reported were interlinked. About 57 % of the respondents commented that the ICS demands continuous supervision and 51.4 % commented that it curtails time from their other productive household activities. This is the impact of their giving more time for continuous supervision during cooking. On the other hand, when they gave break in the continuous supervision and paid attention to other activities like feeding cattle, weaving mats, processing agricultural products etc., they sometimes experienced the house full of smokes or fire hazards. As mentioned earlier, the housing materials in the study area are such that can catch fire easily if left careless during cooking. In TCS, various types of biomass fuel with irregular shapes and sizes can be used simultaneously which is not possible in ICS that needs straight and uniform sized fuel wood sticks as reported by about 63 % respondents. This type of fuel wood cannot be used in ICS due to its structural design that was seen inconvenient to the users who do not want to take extra load of work to cut the rough woods into pieces suitable to burn in ICS. Moreover, dried tree leaves and agricultural residues like paddy straw cannot be used easily in ICS as reported by 31.4 % respondents. In rural Bangladesh, tree leaves serve as a potential cooking fuel, particularly to the poor people who collect it free from forests, roadsides, and their own and neighbors' homesteads. Additionally, paddy straw is also freely available during the paddy harvesting seasons when the villagers use it as fuel. Along with all these negative features, complexity of set up of the ICS was observed as the topmost barrier (74.3 % of respondents) to accept it by the community. Alam et al. (2006) commented that the quality of an ICS depends on its construction and maintenance and problem arise when the stove-maker does not adhere to technical specifications during installation. This may be true for the study area where NSP supplied the technology to selected FUG

members through training, most of whom failed to disseminate the actual design to the users. In real sense, this is the project authority's failure to disseminate the technology properly to such a marginal community as having lower educational background. Elsewhere in the world, ICS programs were not welcomed easily, for instance, in Thailand the three most important barriers to the adoption of ICS were identified as: high cost of investment, lack of information and lack of source of finances (Limmeechokchai and Chawana 2007). But in our case, only lack of information and/or ineffective flow of information could be viewed as the major constraint to convince the FUGs that is evident from the Focus Group Discussion with the community members. Gill (2003) also explored reasons of the failure of ICS programs to achieve widespread dissemination in developing countries. According to Gill, ICS are not necessarily more efficient than TCS designs nor are they always smokeless. Rather, ICS programs emphasize fuel economy whilst stove users regard versatility and the ability to cook quickly as being more important.

4.6 Concluding Remarks and Policy Implications

It has been seen that the ICS program of NSP, i.e., the Forest Department failed to work out in Rema-Kalenga Wildlife Sanctuary, the most biodiversity rich protected area of Bangladesh. The community was found unconvinced with the performance of ICS disseminated by NSP; rather, they reported a number of nuisances of its usage despite the NSP claimed it as a user-friendly and fuel saving device. It depicts that there is a conflict between the two parties—the FD and the local community. The consequences of this conflict represent severe threats to the surrounding forests, particularly when the community was found using TCS with a total dependency on biomass fuels. Therefore, the ultimate impacts would be twofold: more extraction of wood fuel by cutting more trees from forests and thus release of more GWP substances to the atmosphere. The improper manufacture of the stoves might be responsible for exhibiting the inconveniences while the project authority's apathy could be liable to the failure of motivating the users in accepting new technology. Since ICS is very much interlinked to the mitigation of climate change, the authority should be more concern about their effort to influence the stakeholders. Konkin and Hopkins (2009) suggested that in order to succeed in addressing climate change, behavioral change is the key, but most people do not change their behavior because of data or information. The FD should exactly address this point of the local community. Involvement of the local community is imperative in every stage of the program's development. The situation of the study area implies that the existing strategy of the FD is not suitable to resolve the problems. It is realized that to succeed in the implementation of ICS program the proper policy is needed as the first priority. As a result, an alternative strategy is required to obtain proper policy in order to succeed in its implementation. The Sustainable Energy Triangle Strategy (SETS) (Fig. 4.4) could be the appropriate

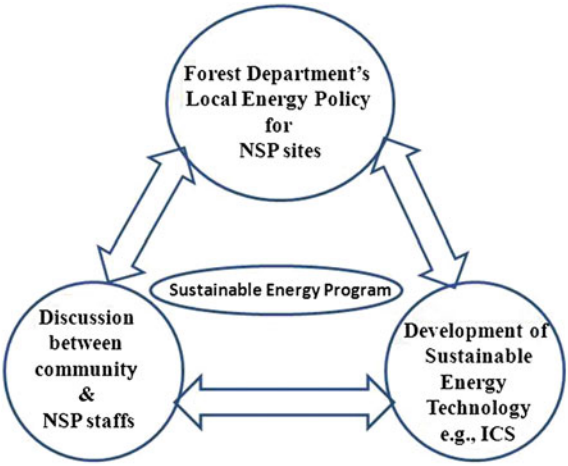

Fig. 4.4 The sustainable energy triangle strategy (SETS)

approach of the ICS implementation as in Thailand. Limmeechokchai and Chawana (2007) described the SETS as: "unlike the traditional top–down approach and strategy, the SETS starts at the users who are the target group of the project. The SETS is designed under the belief that the success of everything is based on the cooperation of concerned people and it will occur when the people understand how it affects them. By using the SETS, the process starts with telling and teaching the target groups about the effectiveness of the use of energy, and then training them to collect and investigate the energy used in their area. The result from this step is the energy situation of that area. The next step is to help them understand about the data of energy used in their area; for example, how much they have to pay for the use of energy compared with the total revenue, how to reduce their energy consumption, and what is the benefit from the energy consumption reduction. Consequently, the energy planning for that area is obtained together with the strategies to reduce energy consumption which are designed by local people and one of those strategies is the ICS".

The SETS was found as the appropriate strategy to promote the use of ICS in Thailand and it would certainly be replicated in the study area. Some other issues could be incorporated during its exercise in Bangladesh such as the assessment of the efficacy of disseminated ICS, making trial with other varieties of ICS used in successful programs in other places like China, Kenya and eastern Africa, in situ demonstration of ICS's positive impacts on health and indoor air quality in the users' cooking place. The Forest Department would involve the national Institute of Fuel Research and Development (IFRD) in these activities. Additionally, campaigning awareness programs on the health and environmental benefits of ICS is to be strengthened through mass media to convince the community for increased usage. Because developing and implementing 'climate change mitigation' necessitate institutional interventions aimed at raising the awareness of society about current and/or future climate changes (Guariguata et al. 2008). Climate change and its

consequences are one of the well-known concerns in policy making level of Bangladesh that has been evident from the country's recent 'voice raise' in the COP-15 in Copenhagen. Similarly, implementation of the appropriate policies in the communities of the root level would result in the protection of forest resources in one hand, and contribute on the mitigation of regional climate change on the other.

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Chapter 5
Major Resource Use from Protected Areas by Local Communities: A Case of Harvesting Medicinal Plants in and Around Rema-Kalenga Wildlife Sanctuary

Mohammad Shaheed Hossain Chowdhury and Masao Koike

Abstract Traditional systems of medicine have become a topic of global importance recently. Increased commercialization of economically important medicinal plants has resulted in overharvesting and threatening their survival. Because lack of data impedes the assessment of the conservation of medicinal plants, ethno-medicinal studies are important to fill this gap. This study considered the importance of medicinal plants, their traditional uses, commercialization, conservation, sustainability and prospects in Bangladesh. At the same time, an attempt was made to establish the link of medicinal plants and protected area management with the involvement of forest dependent local communities. The study was conducted among the local communities living in and around Rema-Kalenga Wildlife Sanctuary. Data collection was predominantly qualitative recording the species use, identifying their relative importance (RI) and assessing the informants' consensus factor (F_{ic}) on associated knowledge. A total of 271 respondents (140 households, 36 professional collectors, 5 herbal practitioners) were interviewed accompanied by field observation and voucher specimen collection. A total of 44 plant species were in use against 33 ailments under 10 broad disease categories. Trees were the most commonly utilized growth form and leaves were the most commonly used plant part. Forested habitats were the major sources of medicinal plants. Five species were found to have high use versatility (RI > 1), *Emblica officinale* L. being the most versatile. Respiratory problems scored the highest F_{ic} value (0.56) involving the use of 30 % species recorded. *Terminalia bellerica* Roxb., *Sterculia villosa* Roxb., *Dillenia pentagyna* Roxb. and *Terminalia*

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M. S. H. Chowdhury (ed.), *Forest Conservation in Protected Areas of Bangladesh*, World Forests 20, DOI: 10.1007/978-3-319-08147-2_5,

arjuna Bedd. were being harvested commercially. Use by the community, particularly for subsistence consumption ensured sustainable harvesting, but commercial extraction of some species appeared unsustainable. Buffer zone-based commercial farming of medicinal plants with a commercial value could serve a dual purpose of assuring sustainable Alternative Income Generation (AIG) for local communities and conserving the natural resources in protected areas.

5.1 Introduction

Until the middle of the 19th century, plants were the main therapeutic agents used by humans (Camejo-Rodrigues et al. 2003). Much of the traditional knowledge concerning new drugs was also discovered at that time (Schultes 1962), though interest has been rekindles in the 1990s (Heinrich 2000). The practices of plant-originated traditional medicine are based on hundreds of years of belief and observations, which predate the development and spread of modern medicine (Aburjai et al. 2006). The World Health Organization (WHO 1991) estimated that about three-quarter of the world population; in particular 3.5 billion in developing countries (Johnson 2009) relied upon traditional remedies that now are being reassessed by extensive activities of research on different plant species and their therapeutic principles (Scartezzini and Speroni 2000). Now, the potential preventive and curative properties of traditional health care systems have been recognized and are being explored (Tetali et al. 2009).

The available modern health care services are not only insufficient but also inaccessible and unaffordable for the majority of developing and least developed nations (Yineger et al. 2008). Joy et al. (1998) noted that more than 80 % of the population of the developing world cannot afford the modern pharmaceutical products, even though many such countries spend 40–50 % of their total wealth on drugs and health care. This situation drives them to look for other options—such as medicines, predominantly from plants, the popularity of which was unveiled by Elliot and Brimacombe (1986); they are relatively cheap, safe and generally easily available. The literature includes many examples of adopting plant-based traditional medicines by the low-income people all over the world, e.g., India (Murthy et al. 2005; Valiathan 2006; Ragupathy et al. 2007), Ethiopia (Yineger et al. 2008), Amazonia (Shanley and Luz 2003), Brazil (Almeida et al. 2006), Jordan (Hudaib et al. 2008; Al-Qura'n 2009), Turkey (Uzun et al. 2004), Cameroon (Focho et al. 2009), Bhutan (Nawang 1996), South Africa (Matsabisa et al. 2009).

Now people in developed countries are turning to traditional medication systems that involve the use of herbal drugs and remedies. Feigin (2007) reported that over 50 % of the population in Europe, North America and other industrialized regions have used a traditional medicine at least once. About 1,400 herbal preparations are widely used in the member states of the European Union being popular

in Belgium, France, Germany and the Netherlands (Hoareau and DaSilva 1999). In the USA, the number of people using herbal medicines has increased from 2.5 % in 1990 to 37 % in 2000 (WWF 2009). In Japan, herbal medicinal preparations are more in demand than mainstream pharmaceutical products (Hoareau and DaSilva 1999). The developed world not only consumes herbal medicines but also is intensively involved in the trade of medicinal plant parts. According to WHO (2003a), the global market for herbal medicines currently stands at over US$60 billion annually and is growing steadily. Cunningham (1996) describes three trading sectors for medicinal plants:

- on the first level, there is national trade which can involve hundreds of species;
- the second level consists of trade across national borders but within the same continent; and
- the third level comprises formal export trade which involves the trade of only a limited number of species in significant volumes.

Bangladesh is biogeographically a transition between the Indo-Gangetic plains and the eastern Himalayas, and part of the Indo-Chinese sub-region of the Oriental realm. Due to its unique biophysical setting—the juxtaposition of a large deltoid freshwater outlet and a large sea fan—Bangladesh is endowed with a surprisingly rich diversity of plant species, estimated to about 6,000 including bryophytes, pteridophytes, gymnosperms and angiosperms (IUCN 2003), about 500 of which are claimed to have medicinal or curative properties (Ghani 2003). A total of 85 % of the country's population live in rural areas and almost 80 % of them are dependent on medicinal plants for primary health care (Hossain 2005 cited in Chowdhury et al. 2009a). Thomsen et al. (2005) recognized the medicinal plants sector in Bangladesh as a priority domain of intervention by many stakeholders. The sector is worth US$14 million with local supply comprising 70 % by volume and 40 % by value (Dixie et al. 2003) with an estimate of around 12,000 tonnes of dried medicinal plants collected from rural, naturally grown areas (Ahmed 2009). In the face of such significance Almeida et al. (2006) saw the recovery of the knowledge and practices associated with these plant resources as part of an important strategy linked to the conservation of biodiversity, the discovery of new medicines, and the bettering of the quality of life of poor rural communities.

The declaration of forests as protected areas is viewed as the fundamental strategy in biodiversity and watershed conservation (Kramer et al. 1997). But experience has shown that legal protection alone is not enough to ensure efficient conservation activities. This can be guaranteed if effective relationships between the conservation areas and local communities are maintained (Schelhas et al. 2002; Mannigel 2008). The collaborative management or co-management approach would be the appropriate strategy to build up the connection and improve the situation (Chowdhury and Koike 2010). Implementation of this strategy has demonstrated positive impacts in five protected areas in Bangladesh, in terms of forest conservation and community livelihood development (Chowdhury et al. 2009b). This approach enhanced local communities' empowerment and increased local involvement in conservation initiatives in Moheli Marine Park of Comoros

Island in the West Indian Ocean (Granek and Brown 2005). A program of sustainable utilization of medicinal plants with similar approach has been initiated involving local farmers in Kakamega forest of Kenya that resulted in reduced pressure on forest herbal resources while providing alternative income to the local community (KFICP 2010).

In Bangladesh protected areas have an intimate interspersion of human habitations, with the traditional dependency of their occupants on the forests. People living in and around the conservation areas of Bangladesh rely extensively on natural resources to meet their subsistence requirements, a considerable portion of which includes medicines (Mukul et al. 2007). Kala (2005) argued that the current trend towards increased commercialization of economically important medicinal plants has resulted in over-harvesting, leading to threats to their future productivity. The fate of tropical forests and of people dependant on them has recently attracted considerable popular interest. Yet, paradoxically, the pace of research into the indigenous plant uses and vegetation management processes that could offer alternatives to the destruction has been dwarfed by the accelerating rates of cultural and biological extinction (Philips and Gentry 1993)—a reality particularly for the developing countries like Bangladesh. Almeida et al. (2006) commented that studies on the knowledge and use of natural resources by local populations may contribute to finding economic alternatives for these populations, especially in terms of the use of medicinal plants for treating health problems.

5.2 Medicinal Plant Resources in and Around Rema-Kalenga Wildlife Sanctuary

The survey recorded 44 plant species belonging to 28 families and 36 genera, used for medicinal purposes by the local communities living in and around Rema-Kalenga Wildlife Sanctuary (Table 5.1). These medicinal plants include trees (34 %), shrubs (32 %), herbs (23 %) and creepers (11 %). In general, trees are the commonest medicinal plants in rural Bangladesh—as evident from several studies (e.g., Miah and Chowdhury 2003; Mukul et al. 2007; Chowdhury et al. 2009a). As rule, protected areas have a rich floral diversity, and in Rema-Kalenga Wildlife Sanctuary a total of 606 plant species were recorded during the period 1998–2000 in a floristic survey (Uddin 2001). This variety allows local communities to collect a wide range of plants and parts of plants for their informal, everyday health care. Similar situations have been reported worldwide; for instances, the use of 101, 58, 40 and 95 medicinal plants by the local inhabitants residing in and around Bale Mountains National Park of Ethiopia (Yineger et al. 2008), Mujib Nature Reserve of Jordan (Hudaib et al. 2008), Satchari National Park of Bangladesh (Mukul et al. 2007) and Velliangiri holy hills of India (Ragupathy et al. 2007), respectively.

Although 28 families with medicinal properties were recorded, only Combretaceae, Euphorbiaceae and Fabaceae were represented by three species; nine families had two species each and the others (16) with one species. Mukul et al. (2007)

Table 5.1 Medicinal plants used by the local community in and around Rema-Kalenga Wildlife Sanctuary

Species		Growth form	Family	Parts used	Ailments	Relative importance (RI)
Botanical Name	Local Name					
Emblica officinale L.	Amloki	Tree	Euphorbiaceae	Fruit	Jaundice, Asthma, Dysentery, Stomach trouble, Apathy to food intake, Fever, Weakness, Malaria	2.00
Terminalia belerica Roxb.	Bohera	Tree	Combretaceae	Fruit	Fever, Apathy to food intake, Weakness, Malaria, Jaundice, Asthma, Gastric pain	1.88
Terminalia chebula Retz.	Hortoki	Tree	Combretaceae	Fruit	Fever, Apathy to food intake, Stomach trouble, Asthma, Weakness, Malaria	1.55
Clerodendrum viscosum Vent.	Bhat	Shrub	Verbenaceae	Leaf	Fever, Gastric pain, Cough, Dysentery	1.10
Trewia nudiflora L.	Chagol Ledi/ Motkila	Tree	Euphorbiaceae	Leaf	Chronic fever, Stomach trouble, Jaundice	1.10
Tamarindus indica (L.) Cogn.	Tentul	Tree	Fabaceae	Tender leaf, Fruit	Burning in urination, Rheumatism, Female disease	0.98
Adhatoda vasica Nees.	Basak	Shrub	Acanthaceae	Leaf	Asthma, Cough, Fever, Cold	0.90
Centella asiatica (L.) Urban.	Thankuni	Herb	Umbelliferae	Whole plant	Stomach trouble, Dysentery, Stammering, Cold	0.90
Ocimum sanctum L.	Tulshi	Shrub	Lamiaceae	Leaf	Leg swelling, Fever, Cough, Cold	0.90
Sterculia villosa Roxb.	Udal	Tree	Sterculiaceae	Tender leaf and twig	Gastric pain, Stomach trouble, Premature ejaculation in male	0.78
Allium ceipa L.	Piaj	Herb	Liliaceae	Tuber	Snake bite, Cold	0.65
Allium sativum L.	Roshun	Herb	Liliaceae	Bulb	Head ache, Stomach trouble in cattle	0.65
Cajanus cajan (L.) Millsp.	Orhor	Shrub	Fabaceae	Leaf	Jaundice, Apathy to food intake	0.65
Dillenia pentagyna Roxb.	Hargeza	Tree	Dilleniaceae	Bark	Cut, Mosquito bite	0.65

(continued)

Table 5.1 (continued)

Species		Growth form	Family	Parts used	Ailments	Relative importance (RI)
Botanical Name	Local Name					
Mikania scandens (L.) Willd.	Uzari/Refugee lota	Creeper	Compositae	Leaf	Cut, Jaundice	0.65
Zingiber officinale Rosc.	Ada	Herb	Zingiberaceae	Tuber	Cough, Flatulence	0.65
Terminalia arjuna Bedd.	Arjun	Tree	Combretaceae	Tender leaf, Bark	Heart disease, Apathy to food intake, Weakness	0.58
Alocasia indica Schott.	Harinpaya	Herb	Araceae	Whole plant	Gastric pain, Stomach trouble	0.45
Azadirachta indica Juss.	Neem	Tree	Meliaceae	Leaf	Scabies, Skin disease	0.45
Ferula asafoitida L.	Heez Gaach	Shrub	Apiaceae	Slender stem	Asthma, Cough	0.45
Jatropha curcas L.	Jamalgota	Shrub	Euphorbiaceae	Latex	Scabies, Skin disease	0.45
Litsea polyantha Juss.	Menda	Tree	Lauraceae	Leaf	Diarrhoea, Dysentery	0.45
Paederia foetida L.	Padra Pata	shrub	Rubiaceae	Leaf	Diarrhoea, Dysentery	0.45
Piper longum L.	Pipul Morich	Creeper (vine)	Piperaceae	Fruit	Cough, Asthma	0.45
Piper nigrum L.	Gol Morich	Creeper (vine)	Piperaceae	Seed	Cough, Asthma	0.45
Abelmoschus moschatus Medik.	Bon Derosh	Shrub	Malvaceae	Root	Leg swelling	0.33
Alocasia spp	Kochu	Herb	Araceae	Petiole	Leeche bite	0.33
Annas comosus (L.) Merr.	Anarosh	Shrub	Bromeliaceae	Tender leaf	Intestinal worm	0.33
Artocarpus lakoocha Roxb.	Dewa	Tree	Moraceae	Tender leaf	Asthma	0.33
Asparagus racemosus Willd.	Shotomuli	Creeper	Asparagaceae	Root	Low content of sperm in male	0.33
Bambusa vulgaris Schred.	Barak Bansh	Tree	Graminae	Bark dust	Cut	0.33
Cassia angustifolia Vahl.	Sonamukhi	Shrub	Fabaceae	Leaf	Gastric pain	0.33

(continued)

Table 5.1 (continued)

Species		Growth form	Family	Parts used	Ailments	Relative importance (RI)
Botanical Name	Local Name					
Cassia fistula L.	Sonalu	Tree	Fabaceae	Tender leaf	Intestinal worm	0.33
Citrullus colocynthis (L.) Schred.	Makal	Creeper	Cucurbitaceae	Fruit	Birth control	0.33
Cynodon dactylon Pers.	Durba	Herb	Graminae	Tender leaf	Cut and wounds	0.33
Datura metel L.	Dhutura	Shrub	Solanaceae	Leaf	Scabies	0.33
Ficus hispida L.	Dumur	Tree	Moraceae	Inflorescence	Diabetes	0.33
Hibiscus rosa-sinensis L.	Joba	Shrub	Malvacea	Flower	Sexual weakness in male	0.33
Lawsonia inermis L.	Mendi	Shrub	Lythraceae	Leaf	Burning in urination	0.33
Leucus aspera Willd.	Dondo Kolosh	Herb	Lamiaceae	Leaf	Cough	0.33
Mangifera indica L.	Aam	Tree	Anacardiaceae	Tender leaf	Asthma	0.33
Solanum indicum L.	Bon Begun	Shrub	Solanaceae	Fruit	Flatulence	0.33
Swertia chirata Ham.	Chirota	Herb	Sapindaceae	Whole plant	Chronic fever	0.33
Zingiber zerumbet Smith.	Ekangi	Herb	Zingiberaceae	Tuber	Gastric pain	0.33

also found that a number of medicinal plant species in the families—Combretaceae and Euphorbiaceae were utilized by the people living around another conservation area in the same region of the study area.

5.2.1 Notes on Plant Utilization

Both the aerial and below ground plant parts are used in health care in the study area—aerial parts 80 %, below ground parts 14 %, and the whole plant 6 %. In some cases different parts were used for treating different ailments; in other cases, similar or different parts of more than one plant were mixed together against a single ailment. Leaves were the most widely used parts accounting for 48 % of the reported medicinal plants, followed by fruit (16 %), bark (7 %), roots (5 %) and others (24 %) that include tuber, bulb, petiole, stem, inflorescence, flower, latex, seed, twig and whole plant. The common use of leaves may be due to their availability, as has also been reported to be in use in many communities (e.g., Giday 2001; Sajem and Gosai 2006; Yineger et al. 2008; Langenberger et al. 2009). The use of leaves is compatible with sustainable harvesting (Halim et al. 2007) and provides with an incentive to protect and maintain wild populations, their habitats and the genetic diversity of medicinal plants (Schippmann et al. 2002). However, Almeida et al. (2006) and Lulekal et al. (2008) recorded that flowers and roots as the mostly used plant parts in northeastern Brazil and southeastern Ethiopia, respectively.

A total of 33 different ailments were found to treat with the medicinal plants recorded. All the ailments were grouped into predefined ethnobotany categories (Heinrich 2000), with the addition of a few others, forming 10 ailment categories: dermatological, gastrointestinal, general health, faunal bites, jaundice, malaria, pain, respiratory, sexual and urinary (Table 5.2). A variety of using pattern of the medicinal plant parts was seen in the study area (e.g., Fig. 5.1). Most plant parts were consumed orally after processing—such as macerating, pounding, squeezing, blending, soaking or boiling in water, rubbing or burning. Some were taken raw and some after cooking as vegetables. Some were applied externally to different body parts for cuts and wounds, scabies, pain or skin diseases. Water was mostly used to dilute the extract from the fresh plant parts. Sometimes, mustard oil, salt, sugar and honey were added to plant parts to make them more palatable. Some unusual ingredients other than plant parts were also reported to be added to some herbal preparations. For example, paste of frog's liver is added to the mixture of extracts from the fleshy stem of *Ferula asafoitida* and leaves of *Mangifera indica* and *Artocarpus lakoocha*, which is then taken orally as a treatment for asthma. The addition of animal parts like goat's milk, chicken's egg, bird's meat; other peculiar items like cattle urine, turtle's blood and chemicals like camphor, vermilion, calcium oxide to local herbal preparation were found in literatures (e.g., Uzun et al. 2004; Owuor and Kisangau 2006; Halim et al. 2007).

Table 5.2 Various ailment categories treated with medicinal plants in and around Rema-Kalenga Wildlife Sanctuary

Ailment category	Biomedical term
Dermatological	Cuts and wounds
	Scabies
	Skin diseases
Gastrointestinal	Diarrhea
	Dysentery
	Flatulence
	Gastric pain
	Intestinal worm
	Stomach trouble
General health	Apathy to food intake
	Cold
	Chronic fever
	Fever
	Heart disease
	Leg swelling
	Stammering
	Weakness
Faunal bite	Leech bite
	Mosquito bite
	Snake bite
Jaundice	–
Malaria	–
Pain	Rheumatism
	Head ache
Respiratory	Asthma
	Cough
Sexual	Birth control
	Female disease
	Low sperm content in male
	Premature ejaculation in male
	Sexual weakness in male
Urinary	Burning in urination
	Diabetes

5.2.2 *Relative Importance of Species and Consensus of Medicinal Knowledge Among Informants*

Five species (about 11 %) of the enlisted medicinal plants were found to have high use versatility (RI $>$ 1): *Clerodendrum viscosum* (1.10), *Trewia nudiflora* (1.10), *Terminalia belerica* (1.88), *Terminalia chebula* (1.55) and *Emblica officinale* (2.00). Among these species exhibiting high relative importance values, a combination of the latter three, popularly known as *Triphala*, has been using for centuries in the folk medicine of Indian sub-continent (Miah et al. 2006), possessing the properties of

Fig. 5.1 The Udal plant (*Sterculia villosa*) and using pattern of its tender twigs

removing toxins and various other undesirable accumulations from the body, improving digestion and assimilation, and acting as antioxidant (Scartezzini and Speroni 2000). As the study area, the other two species are also in use against fever in different regions: *Clerodendrum viscosum* by the *Bantar* people in Nepal (Acharya and Pokhrel 2006) and *Trewia nudiflora* by the neighboring communities of a conservation area in Bangladesh (Mukul et al. 2007).

The F_{ic} values for the disease categories (Table 5.3) indicate the degree of shared knowledge among the respondents for the treatment of ailments by medicinal plants. The greater the consensus factor the more likely that the remedy is biologically efficacious (Owuor and Kisangau 2006). Among the ten ailment categories used in our study, the respiratory problems scored the highest F_{ic} value (0.56). Thirteen species, representing 30 % of the total species recorded, were in use for the treatment of this category that includes asthma and coughs. Jaundice and urinary problems were second (F_{ic} 0.55) and third (F_{ic} 0.50) with the involvement of only five and three species. The gastrointestinal category ranked fourth with an F_{ic} value of 0.43, although the highest number of species (17 species), representing nearly 40 % of the total, were reported to be used in its treatment. A high consensus (0.92) for the treatment of jaundice was found among the *Malasars* community of India (Ragupathy et al. 2007) while the consensus for gastrointestinal illnesses was highest (F_{ic} 0.68) among the *Nahua* community of Mexico (Heinrich 2000). There was no consensus (F_{ic} 0) among the informants in the study area for the categories malaria and pain; perhaps this was because of the easily accessible alternative allopathic medicines available in the dispensaries and/or local shops in the study area. The respondents can buy cheaply the modern pharmaceutical medicine for preliminary pains that provides quick relief, thus reducing the use of traditional remedies. A changing trend towards allopathic medicine for the treatment of malaria, marked in the study area, was reported all over the country.

Table 5.3 Degree of local communities' consensus on managing various ailments in and around Rema-Kalenga Wildlife Sanctuary

Ailment category	No. of plant species	Percentage of total species[a]	No. of use-reports	Informants' consensus factor (F_{ic})
Respiratory	13	29.55	28	0.56
Jaundice	5	11.36	10	0.55
Urinary	3	6.82	5	0.50
Gastrointestinal	17	38.64	29	0.43
General health	13	29.55	20	0.37
Faunal bite	3	6.82	4	0.33
Dermatological	7	15.91	9	0.25
Sexual	5	11.36	6	0.20
Malaria	3	6.82	3	0.00
Pain	2	4.55	2	0.00

[a] Percentage sum exceeds 100 as some species are in use against more than one category

5.3 Collection and Commercialization of Medicinal Plants

Almost all the medicinal plant species in the study area were found to be collected wild from the surrounding forests; being indigenous to the study area except a few like *Allium cepa*, *Allium sativum*, *Piper nigrum*, *Zingiber officinale* and *Hibiscus rosa-sinensis* which are now widespread. The inclination of the respondents towards native species from wild source may be because of their forebears' long-timed acquaintance with the locally available species from whom the knowledge has been traditionally transmitted to the present generation. This preference for the wild harvested medicinal plants is seen in local users throughout the world. The *Shaiji* people (Halim et al. 2007) and *Garo* tribe (Anisuzzaman et al. 2007) in Bangladesh, traditional healers in Ethiopia (Yineger and Yewhalaw 2007), local people in China (Lee et al. 2008) are the few examples. Kuipers (1998) reported an estimated 70–90 % of the medicinal plant material imported into Germany is harvested from the wild while more than 500 species are harvested from the wild in France. Uniyal et al. (2000) commented that medicinal properties of plant secondary metabolites produced under stress and competition are not always expressed in fast-growing monoculture; rather, higher levels of active compounds may be present in wild populations where they grow more slowly.

There is no official provision for collecting medicinal plants commercially from Rema-Kalenga Wildlife Sanctuary; all were extracted illegally. Fruits of *Terminalia bellerica*, tender twigs of *Sterculia villosa*, barks of *Dillenia pentagyna* and *Terminalia arjuna* were found to be harvested for commercial purposes while the others for subsistence use. They reported the sale of commercially harvested parts of medicinal plants to the middlemen and/or local market with a marginal price (Table 5.4). The local people collected the fruits of *T. bellerica* from the forest floor after their shedding at maturity; cut the tender twigs of *S. villosa* by climbing trees, sometimes twisting and breaking down the whole branch; and scrapped off the bark of *D. pentagyna* and *T. arjuna* with a sharp knife from the mature bole of

Table 5.4 Information on selling price of commercially harvested medicinal plant parts in and around Rema-Kalenga Wildlife Sanctuary

Species		Parts harvested	Selling price (Tk[a]/kg)
Botanical name	Local name		
Dillenia pentagyna	Hargeza	Bark	6.00
Sterculia villosa	Udal	Tender twig	10.00
Terminalia belerica	Bohera	Fruit	4.00
Terminalia arjuna	Arjun	Bark	20.00

[a] Bangladeshi currency unit Taka; 1 US$ = 68 Tk (as of March 2010)

standing trees (Fig. 5.2). Among these four locally traded plant parts; bark of *D. pentagyna* was reported to be used for making a mosquito repellent while the others were used against human ailments.

5.3.1 *Sustainability, Hygiene and Guidelines for Commercial Extraction of Medicinal Plants*

The worldwide current trend towards unsustainable extraction of medicinal plants from natural habitats has resulted in over-harvesting, leading to threats to future productivity (Kala 2005). In contrast, careful exploitation of medicinal plants can provide an opportunity for local development (Purohit and Vyas 2007). In the study area, sign of unsustainable extraction of plant parts, especially those harvested commercially was manifested from the opinion of the respondents. This resulted in the gradual decrease in the daily amount collected and ultimately in the disappearance of those species from the sanctuary. The reduction of some selected species is also evident from the comment of an elderly respondent (Mr. Surya Deb Borma, 65 years of age) "in my childhood there was an abundance of *Hargeza* plant (*D. pentagyna*), but now-a-days I see only a few all over the forest" (Fig. 5.3). It is also reflected in Table 5.5, which shows that the daily amount of the medicinal plant parts harvested/collected per person was decreased than that of the 5 years before. Conversely, the distance traveled by the collectors for harvesting the parts was found increased than that of the 5 years before for all the four plants. All the respondents opined that scarcity of the respective species is the only the reason for the reduction of the amount harvested and increase in the distance traveled to reach the species. This suggests the gradual reduction of these specific species from the sanctuary. Uddin and Roy (2007) also reported the decreasing amount of daily collection per person of parts from *Litsea glutinosa* and *T. bellerica*. The amount of bark collection from *L. glutinosa* has decreased to 2 kg and fruit from *T. bellerica* to 10.5 kg whereas the amount was 10 and 30 kg, respectively 5 years ago, suggesting a developing scarcity of those two plants in the sanctuary. Moreover, frequent scrapping of barks makes the trees more susceptible to injury, sometimes killing the species (Graham 2007) and collecting fruits from the forest floor may affect the regeneration potential (Uddin and Roy 2007).

Fig. 5.2 The trunks of Arjun (*Terminalia arjuna*), once the bark is scrapped away

In such circumstances, to measure the attitude of the collectors, the respondents were supplied with four comments and asked for giving their opinions (Table 5.6). In response, they 'strongly agreed' to the comment "there is a gradual reduction of these species", "these species should be conserved for the enrichment of the local biodiversity" and "I (the respondent himself/herself) want to contribute in species conservation". But instead of agreeing strongly, they just 'agreed' on the comment

Fig. 5.3 The old man as the witness of gradual decrease of Hargeza plant (*Dillenia pentagyna*) from Rema-Kalenga Wildlife Sanctuary

Table 5.5 Amount of medicinal plant parts collected and distance travelled for the collection in the Rema-Kalenga Wildlife Sanctuary

Species local name	Avg. no. of collector per day	Amount collected (kg/persn/day)	Amount Collected 5 years ago (kg/persn/day)	Avg. daily income from MPs (Tk/persn/day)	Avg. distance travelled presently (km)	Avg. distance travelled 5 years ago (km)
Hargeza	4	1.5	10	9.00	9–10	5–6
Udal	Seasonal (April–June)	8	15	80.00	7–8	4–5
Bohera	Seasonal (Sept.–Dec.)	9.5	21.5	38.00	7–8	4–5
Arjun	3	3	7	60.00	9–10	5–6

"overharvesting of the parts and illegal cutting of plants are the reasons behind the scarcity of those species".

The post-collection processing of the commercially collected medicinal plant parts is improper and unhygienic (Fig. 5.4). Most of the respondents (86 %) opined that the processing of medicinal plant parts is not hygienic but they did not think the matter in this way before. The remaining (14 %) did not have any idea of hygiene of the processing at all. Most of the plant parts need to be dried before marketing. During the study, it was seen that the fruits of *T. bellerica*, and barks of *T. arjuna* and *D. pentagyna* were spread over the bare ground of the homestead yard, which was

Table 5.6 Attitude of medicinal plant part collectors towards the status and conservation of commercially used medicinal plant species in Rema-Kalenga Wildlife Sanctuary

Comments/questions	Mean value	Remarks
There is a gradual reduction of these species	5.00 (SE, 0.07)	Agree strongly
Overharvesting of the parts and illegal cutting of the species are the reasons behind the scarcity	4.10 (SE, 0.06)	Agree
These species should be conserved for the enrichment of local biodiversity	4.73 (SE, 0.10)	Agree Strongly
You want to contribute in species conservation	5.00 (SE, 0.04)	Agree strongly

Fig. 5.4 Fruits of Bohera (*Terminalia bellerica*) is sun-dried in open ground buffed with cow-dung; after drying, the same fruits are stored in basket buffed with cow-dung; stored fruits contaminated with foreign matters; and dried bark of Arjun (*Terminalia arjuna*) stored in sack

buffed with cow-dung to make the surface smooth facilitating quick sun drying. As most of these plant parts are soaked in water and the liquid extract thus obtained is taken orally for treating some ailments, contamination may make these parts precarious instead of curative through the risk of introducing new infections. The World Health Organization (WHO) enunciated a set of guidelines for the collection and processing of medicinal plants. According to the guidelines, collection practices should ensure the long-term survival of wild populations and their associated habitats, and drying medicinal plant material directly on bare ground should be avoided (WHO 2003b). It suggests laying the medicinal plant parts on a tarpaulin or

other appropriate cloth or sheeting, if a concrete or cement surface is used. In the case of drying in the open air, the parts should be spread out in thin layers on drying frames and stirred or turned frequently; the drying frames should be located at a sufficient height above the ground to secure adequate air circulation.

5.4 Implications for Protected Area Management

Local communities suffer after the notification of a forest as protected area due mainly to the curtailment of the flow of forest resources for their livelihoods through strict regulation. Consequently, effective maintenance of the relationships between protected areas and the local communities has been emphasized in their management as community participation is seen as an important factor in nature conservation (Mannigel 2008). Successful conservation schemes can be achieved only if effective incentives are offered to the local communities and their roles are clearly defined of (Sawhney et al. 2007). In Rema-Kalenga Wildlife Sanctuary, many aspects of forest resource utilization are responsible for the degradation (Fig. 5.5). The Alternative Income Generating (AIG) activities, introduced by the NSP, with a view to reducing pressures on protected areas are: cow fattening both for beef and milk, poultry rearing, nursery production, improved stoves manufacture, nature tourism and eco-lodge, eco-guiding, service enterprises, elephant rides as tourist amusement, tribal cloths manufacture, date palm leaf baskets manufacture, social forestry in buffer zone for poles/logs, fuel wood and medicinal plants, direct payments for conservation, access to capital through NGO microfinance, CMC-led microfinance, linkages to existing Micro Finance Institutions (MFIs) and matching grants (DeCosse 2006).

Although medicinal plants cultivation was mentioned in the project plan as one of the AIGs, no such activity was reported in the study area. Rather, the local communities were given training in some activities that do not reflect their needs. The authority is not emphasizing on medicinal plant-based AIG or even recognizing it as a potential means of livelihood, which is evident from its exclusion from the list of resource collection as presented in Fig. 5.4. But, as per the findings of the present study, the introduction of commercial cultivation of medicinal plants could be a step forward in the attempt to direct local communities towards other livelihood activities. The adjacent portion of reserve forest that is acting as informal buffer zone and the homesteads of Forest Villages could be the appropriate sites for this initiative. Because of their acquaintance with and high dependence on the plants for medicinal uses, the local people have an intimate understanding of the ecology and, in some cases, the culture of different species; this could easily provide the basis for commercial farming of medicinal plants. Small-scale agroforestry programs could be initiated for intercropping of medicinal plants with horticulture and agricultural crops to optimize the production per unit area. The driving role of the Forest Department could give it an institutionalized look. The Himalayan Forest Research Institute of Shimla has established

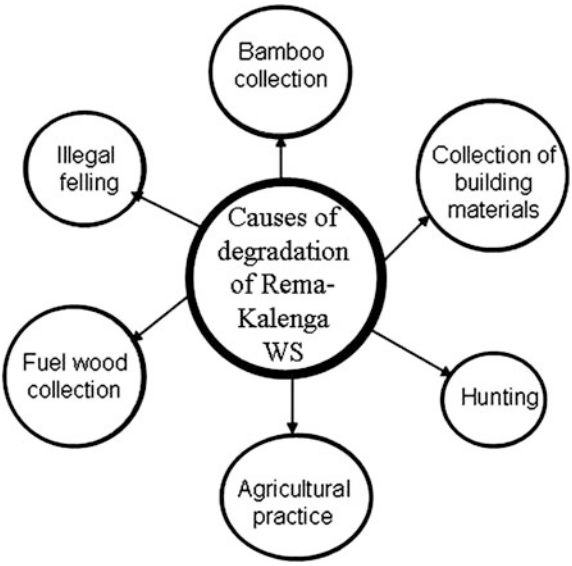

Fig. 5.5 Causes of degradation of Rema-Kalenga Wildlife Sanctuary

such agroforestry models in the State of Himachal Pradesh, India (NVO News 2009). The commercial cultivation of medicinal plants involving rural communities has been successfully adopted in many other countries, e.g., India (Chatterjee 2002; Purohit and Vyas 2007), Ghana (Dennis and Owusu-Afriyie 1999), Sri Lanka (De Silva and Wettasinghe 2004), Malaysia (Lee 2004) and South Africa (Wiersum et al. 2006). Small-scale cultivation of some medicinal plants has been initiated in different places of Bangladesh also, for instances, 17 species in the homegardens of Manikganj by the rural people (Akand 2005), *Lawsonia inermis* L. in the central portion of the country by the local farmers (Chowdhury et al. 2010) and *Swertia chirata* Ham. in Madhupur Sal Forest area by the *Garo* tribe (The Independent 2010). The cultivation is being practiced inside the forests as well. The *Bhotiya* tribal community practice seasonal and altitudinal migration and stay inside the buffer zone of Nanda Devi Biosphere Reserve in the western Himalaya of India and cultivate medicinal plants (Silori and Badola 2000). Becker and Workman (2003) suggested the cultivation of some shade tolerant medicinal plants for forest farming[1] in Florida's forests. FAO (2003) recognized the cultivation of medicinal plants as a 'conservation option' for threatened species and a means for relieving harvest pressure on wild populations.

The demand for medicinal plant material is expected to increase by Tk 300 million by value (Dixie et al. 2003), mainly concerning *Emblica officinale, Terminalia bellerica, Terminalia chebula, Asparagus racemosus, Withania somnifera*

[1] Forest farming is defined as the cultivation of plants under a forest canopy as opposed to wild crafting, the practice of collecting wild plants and products from a forest (Becker and Workman 2003).

and *Andrographis paniculata* (Dixie et al. 2003), especially the *Triphala* species (myrobalan) widely used all over the country (Miah et al. 2006). Marketing of medicinal plant parts should not be a major problem since there are about 500 herbal industries of which 20 are large and consume 80 % of the total raw material of the country (Ahmed 2009). Moreover, Ahmed was informed by the Hamdard Laboratories, the largest manufacturer of finished herbal products in Bangladesh, of their keenness to purchase locally produced dried plants. Thus medicinal plants farming could be a potential means of livelihoods for the forest dependent marginal people in the study area. The rural people of Natore, a northern district of Bangladesh devoid of natural forests, have adopted such farming and started earning from the medicinal plants trade (Sheuly 2008). In the focus group discussion, the community people showed their desire to cultivate medicinal plants commercially but, at the same time, expressed worries about the supply of planting material and associated technology for the initial establishment. In the quest of this, the Bangladesh Council for Scientific and Industrial Research (BCSIR) and Bangladesh Forest Research Institute (BFRI) can develop an 'elite repository' for producing quality planting (Thomsen et al. 2005). Besides, the project implementation authority can provide the community with appropriate training following the WHO guideline on 'good agricultural and collection practices (GACP) for medicinal plants'.

The other option—the controlled harvesting from wild—will require the incorporation of local people's indigenous knowledge into management matters. Kala (2005) stated that indigenous methods of utilization of natural resources, in many cases, are regarded as sustainable. In our study area, the community was found to show some degree of sustainability by harvesting leaves as mostly used plant part. Conversely, they were reported to act as the agent of reducing some species by overharvesting barks and fruits; this causes the mortality and hampers the regeneration of those species, respectively leading to population decline. Therefore, a cautious scrutiny is needed to identify the effective local knowledge so as to use it as a key factor in species conservation in the protected area.

5.5 Conclusion

Plant-based ethno-medicines occupy a vital share of the health care systems in the developing world. But medicinal plants started disappearing rapidly due to their commercialization, increased demand and unsustainable harvesting. Therefore, it is important to ensure their conservation for sustainable utilization. The present study highlights this aspect. In correspondence with the FAO's recognition of the cultivation of medicinal plants as a 'species conservation option', buffer zone-based commercial cultivation of widely demanded medicinal plants was suggested in the areas of Rema-Kalenga Wildlife Sanctuary, Bangladesh. It would, therefore, promote the alternative livelihoods for the local community on one hand; reduce the pressure on the protected area on the other.

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Chapter 6
Impact of Co-management on Rural Development: Evidence from Community Survey in and Around Rema-Kalenga Wildlife Sanctuary

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Abstract Community involvement in protected area management is a recent initiative in Bangladesh. It was started with two major goals of checking forest degradation and enhancing the community development. In this section, we focused on the latter by conducting an exploratory community survey in and around Rema-Kalenga Wildlife Sanctuary. A total of 302 randomly selected members of the Forest User Groups (FUGs) were interviewed, 23 % being the female. A satisfactory level of development has been observed in the socio-economic conditions of the community as the impact of the new management strategy. The provision of incentives in terms of training for Alternative Income Generating (AIG) activities and allotment of available vacant lands for agriculture had significant contribution to the increase in the community's annual income. Empowerment and improved social dignity of women participants signifies the introduction of the co-management approach there. Lack of accurately need-based AIG options, inequality and inequity in the distribution of trainings among the FUG members and absence of pro-people manners of the local Co-management Committee were identified as the key incongruities, which need to be addressed properly for achieving the absolute success of the participatory programs of protected area management in Bangladesh.

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M. S. H. Chowdhury (ed.), *Forest Conservation in Protected Areas of Bangladesh*, World Forests 20, DOI: 10.1007/978-3-319-08147-2_6,

6.1 Introduction

Protected areas embedded in human-dominated landscapes are the norm in most parts of the world (DeFries et al. 2010). Eighty percent of parks in Latin America have people living in them (Amend and Amend 1995). Throughout Europe, protected areas are commonly inhabited by legal residents; in India, the number of people living inside protected areas is estimated at between 3.5 and 4 million (Kothari et al. 1995). There are 30 million poor people who live in and around protected areas in China (Jing-wen et al. 2001). Typically, communities living in and around the protected areas are income-poor and population growth in these areas is booming at twice the world's average hence exerts more pressures on their resources (Buck et al. 2007). It has been a perpetual narrative for protection of various potential areas for nature or recreational purposes to exclude humans and other species (Adams and Hulme 2001). The pressure on protected areas is basically from the communities' dependence upon conservation areas for their livelihoods. In Africa alone, 600 million people have been estimated to rely on forests and woodlands including the conservation areas for their livelihoods (Anderson et al. 2006). With regards to specific resource use pattern, in Lao PDR, a total of 81 rural communities depend on the Nam Et-Phou Loei region for non-timber forest products (NTFPs), the value of which is estimated at US$1.88 million/year (ICEM 2003). Protected areas provide various services at large scale too, beyond their physical landscape and boundaries. For instance, 33 of the world's 105 largest cities obtain a significant proportion of their drinking water from protected areas (SCBD 2008). More specifically, around 85 % of San Francisco's drinking water comes from Yosemite National Park, USA (NRDC 2003), 80 % of Quito's 1.5 million population use drinking water originating from the Antisana and the Cayambe-Coca Ecological Reserves in Ecuador (Pagiola et al. 2002), and the water sources for Rio de Janeiro are protected by 14 protected areas and the Atlantic Rainforest Biosphere Reserve in Brazil (Sericchio 2003). These demonstrate that protected areas are providing various services and securing community livelihoods at various dimensions and levels. Therefore, inhibiting the local people's access to protected areas can be viewed as impractical, unaffordable, and ethically questionable (Buck et al. 2007). Generally, protected area managers exclude local people who previously and hitherto have had access to the resources therein (Holmern 2003). Very commonly, the conservation strategies cause local livelihoods to conflict with conservation since local people are forced to use resources outside the conservation areas (Salafsky and Wollenberg 2000). Among the six IUCN categories of protected areas, four do not allow consumptive use of the resources by strictly defining borders that unauthorized people are not supposed even to cross (Wapalila 2008). Boissiere et al. (2010) conceded that the decision to keep local communities out of and away from protected areas actually leaves the way open to encroachment by outsiders and timber smugglers, who the local communities have no control over, and thus forest degradation accelerates.

Rather, promoting alternative livelihoods around protected areas is an obvious management opportunity to reduce pressure on them (Kiss 2004).

Although protected areas are proven to be important for conservation, the concept faces difficult challenges and dilemma interrelated with rural development and biodiversity conservation (Holmern 2003). Many conservationists working in developing countries consider conservation in protected areas to be unsustainable unless local communities become an integral part of their management (Infield and Namara 2001). Moreover, according to social advocates, the only initiatives related to poverty alleviation will lead to successful biodiversity conservation because only these initiatives address the root cause of environmental destruction (Wilkie et al. 2006). Therefore, as an outcome of the increasing researches in social science, the relationship between people and protected areas has been evolved into a management partnership, termed as collaborative management or co-management, involving all the major stakeholders (Oli 1999). This is the approach where "two or more social actors negotiate, define and guarantee amongst themselves a fair sharing of management functions, benefits, mandates, and responsibilities for a certain area or a set of natural resources" (Borrini-Feyerabend et al. 2004). Sometimes referred to as joint management, co-management involves "institutional arrangements whereby governments and local communities enter into formal agreements specifying their respective rights, powers and obligations with reference to the management and allocation of resources in a particular area" (Berkes and Henley 1997).

In Bangladesh, recognizing the inadequacy of traditional forest management and the continued degradation and depletion of forest resources, the government has been exploring various conservation options (Rana et al. 2007). Of these, the establishment of protected areas and the gradual adoption of community involvement in resource management are the two important strategies (Chowdhury et al. 2009). A total of 20 protected areas are in Bangladesh and co-management approach has been initiated in five of them as a donor assisted project with the name Nishorgo Support Project (NSP) and financial assistance of USAID (Chowdhury and Koike 2010a). This section discusses the impact of incentives provision in co-management program on the socio-cultural and economic condition of the local communities.

6.2 Human Capital

6.2.1 Overall Basic Socio-Demographic Features of the Respondents

The average age of the respondents was 41.38 (SE, 0.63) years, most of who were illiterate (77.5 %). The average size of their families was 6.14 (SE, 0.14) with average annual household income of Tk. 43517.88 (SE, 1203.35), nearly half of

Table 6.1 Basic socio-economic and demographic features of the respondents in RKWS

Parameters		Relative frequency
Farmers' age (years)		41.38 (SE, 0.63)
Average household size	Total	6.14 (SE, 0.14)
	Male	3.30 (SE, 0.09)
	Female	2.83 (SE, 0.08)
Education (%)	Illiterate	77.5
	Primary	17.9
	Secondary level	4.6
Average annual income (Taka)		43517.88 (SE, 1203.35)
Solvency status (%)	Solvent	39.7
	Surplus	3.3
	Short-term insolvent	48.3
	Long-term insolvent	8.6
Average land holdings (decimal)	Homestead	24.26 (SE, 1.09)
	Agro-land (own)	11.58 (SE, 2.19)
	Agro-land (leased from FD)	177.27 (SE, 9.40)
Housing status (%)	Tin-shed bamboo fenced	17.5
	Thatching grass bamboo fenced	27.2
	Mud-walled bamboo fenced	55.3
Livestock possession (%)	Yes	98.7
	No	1.3

them (48.3 %) being short-term insolvent throughout the year. Most of them were farmers (72.8 %) having varied landholdings such as homesteads, agricultural lands of their own and leased from the FD (Table 6.1). The housing status of the respondents was dominated by mud-walled bamboo fenced category (55.3 %) followed by thatching grass bamboo fenced (27.2 %) and tin-shed bamboo fenced (22.5 %). Almost all the respondents (98.7 %) possessed various livestock (cattle, buffalo, goat, pig, chicken and duck) in their homes. The respondents were from both the *Bangalee* and tribal communities dominated by male (76.8 %). They covered all the stake levels (major, medium, minor-medium and minor) and positions (inside, adjacent and outside) of villages all around RKWS (Fig. 6.1).

6.2.2 Environmental and Hygiene Concerns

All the respondents, irrespective of category of any kind, were found to be knowledgeable about the importance of safe drinking water and using sanitary toilet, and the importance of education (Table 6.2). But only about 60 % of them sent their children to school. They were found to possess a strong hygiene and health concern, particularly about keeping house and yard clean (87.7 %), over population as a problem (97 %) and the urgency of its check (98.7 %), but only about 32 % of them reported to adopt birth control measure. About 60 % of the

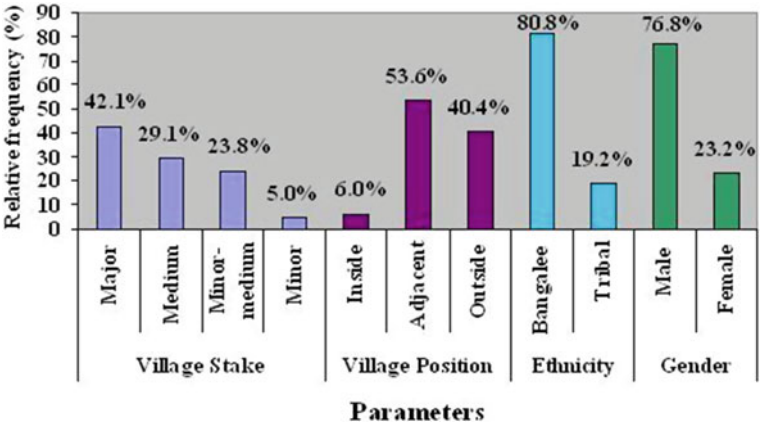

Fig. 6.1 Category-wise respondents' detail in the study area

respondents did not have any knowledge about the mosquito-borne disease dengue, 64 % suffered from any disease in the recent year and the treatment method was dominated by traditional medicines (45 %).

6.3 Physical Capital

6.3.1 Housing, Major Utility and Livestock Status

Most of the houses (55.3 %) were mud-walled bamboo fenced in the surrounding communities of Rema-Kalenga Wildlife Sanctuary. On an average, three rooms were found per house; significant difference in the number was seen in the respondents according to ethnicity and gender categories, no significant difference was found in other categories (Table 6.3). The frequency of the possession of two major every day utility like tube well and sanitary toilets was low among the respondents; only about 37 and 22 % of them possessed tube well and sanitary toilet, respectively. If considered category-wise, the situation was realized severe for the respondents living inside the sanctuary and those having minor stake to it. The former possessed neither sanitary toilet, while the latter possessed neither the tube well nor the sanitary toilet at all.

Almost all the respondents (98.7 %) were found to possess livestock of various kinds such as cattle, buffalo, goat, pig, chicken, and duck (Table 6.4). The number of chicken and duck were found highest (2.21; SE, 0.19) and goat was lowest (0.85; SE, 0.09). No pig was found among the *Bangalee* respondents. The average number of pig significantly differed among the respondents in all categories, while the chicken differed only ethnicity-wise and duck both ethnicity and gender-wise.

Table 6.2 Environmental and hygiene concerns of the respondents

Parameters and comments	Relative frequency of the respondents (%)											
	Overall	Village position			Village stake				Ethnicity		Gender	
		Inside	Adjacent	Outside	Major	Medium	Minor-medium	Minor	Bangalee	Tribe	Male	Female
Do you know the importance of safe drinking water?												
Yes	100	100	100	100	100	100	100	100	100	100	100	100
Do you know the importance of using sanitary toilet?												
Yes	100	100	100	100	100	100	100	100	100	100	100	100
Do you know the importance of education?												
Yes	100	100	100	100	100	100	100	100	100	100	100	100
Do you send your children to school?												
Yes	59.9	16.7	61.1	64.8	59.8	60.2	68.1	20.0	67.2	29.3	57.3	68.6
No	40.1	83.3	38.9	35.2	40.2	39.8	31.9	80.0	32.8	70.7	42.7	31.4
Do you know about the disease Dengue and its carrier mosquito?												
Yes	40.1	11.1	40.1	44.3	39.4	40.9	48.6	–	46.7	12.1	37.1	50.0
No	59.9	88.9	59.9	55.7	60.6	59.1	51.4	100	53.3	87.9	62.9	50.0
Do you keep your house and yard clean?												
Yes	87.7	94.4	89.5	84.4	88.2	87.5	84.7	100	86.9	91.4	84.1	100
No	12.3	5.6	10.5	15.6	11.8	12.5	15.3	–	13.1	8.6	15.9	–
Do you think that population is a problem?												
Yes	97.0	100	96.9	96.7	96.9	97.7	95.8	100	96.7	98.3	97.4	95.7
No	3.0	–	3.1	3.3	3.1	2.3	4.2	–	3.3	1.7	2.6	4.3
Do you think that it is necessary to check?												
Yes	98.7	100	98.1	99.2	98.4	98.9	98.6	100	98.8	98.3	99.6	95.7
No	1.3	–	1.9	0.8	1.6	1.1	1.4	–	1.2	1.7	0.4	4.3

(continued)

Table 6.2 (continued)

Parameters and comments	Relative frequency of the respondents (%)										
	Overall	Village position			Village stake				Ethnicity		Gender	
		Inside	Adjacent	Outside	Major	Medium	Minor-medium	Minor	Bangalee	Tribe	Male	Female
Do you adopt family planning measure?												
Yes	31.8	22.2	32.7	32.0	32.3	29.5	36.1	20.0	33.6	24.1	32.3	30.0
No	39.4	66.7	37.0	38.5	37.0	39.8	36.1	73.3	34.4	60.3	46.1	17.1
N/A	14.6	11.1	14.2	15.6	14.2	15.9	15.3	6.7	17.2	3.4	17.2	5.7
N.C.	14.2	–	16.0	13.9	16.5	14.8	12.5	–	14.8	12.1	4.3	47.1
Did you suffer from any disease last year?												
Yes	64.2	72.2	67.3	59.0	66.9	61.4	59.7	80.0	63.5	67.2	71.6	40.0
No	35.8	27.8	32.7	41.0	33.1	38.6	40.3	20.0	36.5	32.8	28.4	60.0
Which treatment method do you use?												
Mod.	16.9	5.6	16.7	18.9	18.1	14.8	20.8	19.0	20.5	1.8	17.7	14.3
Trad.	45.0	83.3	45.7	38.5	46.5	45.5	34.7	40.6	36.5	81.0	49.6	30.0
Both	38.1	11.1	37.7	42.6	35.4	39.8	44.4	40.4	43.0	17.2	32.8	55.7

Table 6.3 Housing type and major utility status of the respondents

Category		Housing type (%)				Tube well possession		Sanitary toilet possession	
		TSBF	Th.GBF	MWBF	Average room no.	Yes	No	Yes	No
Overall		17.5	27.2	55.3	3.0 (SE, 0.05)	36.8	63.2	21.5	78.5
Village position	Inside	11.1	38.9	50.0	2.83 (SE, 0.15)[a]	16.7	83.3	–	100
	Adjacent	19.8	23.5	56.7	3.05 (SE, 0.07)[a]	42.0	58.0	24.1	75.9
	Outside	15.6	30.3	54.1	2.98 (SE, 0.08)[a]	32.8	67.2	21.3	78.7
Village stake	Major	22.1	14.4	53.5	3.08 (SE, 0.08)[a]	39.4	60.6	21.3	78.7
	Medium	11.4	29.5	59.1	3.00 (SE, 1.0)[a]	38.6	61.4	25.0	75.0
	Minor-medium	19.4	29.2	51.4	2.93 (SE, 0.11)[a]	37.5	62.5	22.2	77.8
	Minor	6.7	26.6	66.7	2.87 (SE, 0.13)[a]	–	100	–	100
Ethnicity	Banglee	20.1	24.6	55.3	3.07 (SE, 0.06)[a]	41.8	58.2	26.2	73.8
	Tribe	6.9	37.9	55.2	2.78 (SE, 0.09)[b]	15.5	84.5	1.7	98.3
Gender	Male	21.1	23.3	55.6	3.09 (SE, 0.06)[a]	33.2	66.8	19.8	80.2
	Female	5.7	40.0	54.3	2.73 (SE, 0.09)[b]	48.6	51.4	27.1	72.9

TSBF tin-shed bamboo fenced, *Th.GBF* thatching grass bamboo fenced, *MWBF* mud-walled bamboo fenced

[a,b] Values are significantly different at $p < 0.05$ significance level

Table 6.4 Average number of livestock the respondents have in their homesteads

Category		Average livestock number					
		Cattle	Buffalo	Goat	Pig	Chicken	Duck
Overall		1.43 (0.08)	0.17 (0.05)	0.46 (0.07)	0.85 (0.09)	2.21 (0.19)	2.21 (0.19)
Village Position	Inside	1.11 (0.27)[a]	0.59 (0.59)[a]	0.78 (0.33)[a]	2.78 (0.43)[a]	6.22 (1.44)[a]	0.22 (0.15)[a]
	Adjacent	1.52 (0.12)[a]	0.16 (0.07)[a]	0.38 (0.08)[a]	0.76 (0.11)[b]	10.47 (0.59)[a]	2.39 (0.26)[b]
	Outside	1.36 (0.13)[a]	0.11 (0.04)[a]	0.53 (0.12)[a]	0.68 (0.12)[c]	9.78 (0.61)[a]	2.26 (0.30)[c]
Village stake	Major	1.50 (0.13)[a]	0.21 (0.09)[a]	0.40 (0.10)[a]	0.80 (0.13)[a]	10.51 (0.70)[a]	2.41 (0.31)[a]
	Medium	1.44 (0.16)[a]	0.17 (0.12)[a]	0.53 (0.14)[a]	0.97 (0.16)[b]	9.35 (0.70)[a]	1.97 (0.28)[a]
	Minor-medium	1.31 (0.17)[a]	0.13 (0.05)[a]	0.50 (0.15)[a]	0.50 (0.13)[c]	10.21 (0.79)[a]	2.53 (0.44)[a]
	Minor	1.47 (0.40)[a]	–	0.47 (0.26)[a]	2.27 (0.48)[d]	7.20 (1.67)[a]	0.40 (0.21)[a]
Ethnicity	Bangalee	1.50 (0.10)[a]	0.17 (0.05)[a]	0.48 (0.08)[a]	–[a]	10.44 (0.47)[a]	2.63 (0.22)[a]
	Tribe	1.16 (0.16)[a]	0.18 (0.18)[a]	0.41 (0.13)[a]	1.83 (0.24)[b]	7.83 (0.24)[b]	0.43 (0.12)[b]
Gender	Male	1.51 (0.10)[a]	0.17 (0.07)[a]	0.47 (0.07)[a]	1.08 (0.11)[a]	9.80 (0.49)[a]	1.97 (0.18)[a]
	Female	1.19 (0.16)[a]	0.17 (0.07)[a]	0.44 (0.17)[a]	0.09 (0.04)[b]	10.40 (0.75)[a]	2.99 (0.52)[b]

Values in parentheses indicate the standard error of means

[a,b,c,d] Values are significantly different at $p < 0.05$ significance level

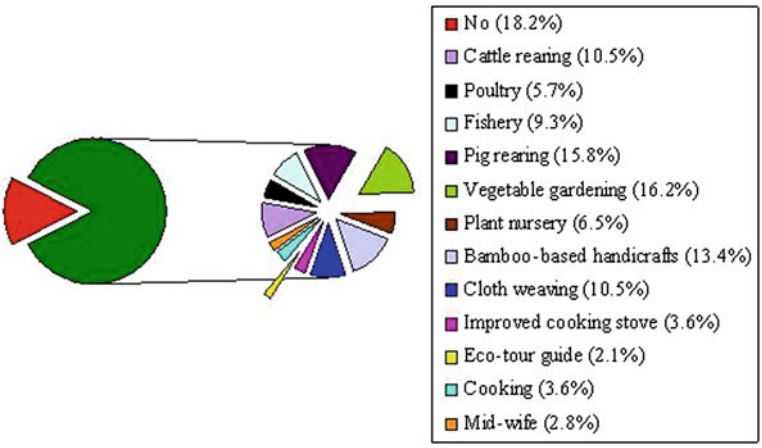

Fig. 6.2 Types of AIG training given to the respondents in the study area

6.3.2 The Incentives in the Form of AIG Trainings

About 82 % of the respondents received training from the Forest Department on various Alternative Income Generation (AIG) activities, while the remaining (18 %) did not receive any training yet. Training on a total of 12 AIG options was given to the FUG members based on the selection by the Co-management Committee.

Among the respondents who received AIG training, the highest portion (16.2 %) was given training on vegetable gardening followed by pig rearing (15.8 %), bamboo-based handicrafts (13.4 %), cattle rearing (10.5 %), cloth weaving (10.5 %), fishery (9.3 %) and so on (Fig. 6.2). Most of them (81.8 %) reported about the increase in their skill due to the trainings they received from the Forest Department (Table 6.5). However, almost all of them (93.7 %) demanded for more training, mostly on activities different from the ones they had already received (Fig. 6.3). Table 6.6 lists the activities, on which they demanded more training, where cattle rearing ranked the highest position (40.4 %).

6.4 Natural Capital

6.4.1 Incentives in the Form of Allocation of Agricultural Land

On an average the respondents possessed 24.26 (SE, 1.09) decimal of land for homestead and 11.58 (SE, 2.19) decimal of own agricultural land. The Forest Department allotted the vacant plain lands inside the sanctuary to the local

Table 6.5 Respondents' view on the state of their skill after receiving AIG trainings

Category		Frequency (%)	
		Yes	No
Overall		81.8	18.2
Village position	Inside	88.9	11.1
	Adjacent	83.3	16.7
	Outside	78.7	21.3
Village stake	Major	82.7	17.3
	Medium	81.8	18.2
	Minor-medium	77.8	22.2
	Minor	93.3	6.7
Ethnicity	*Bangalee*	79.1	20.9
	Tribe	93.1	6.9
Gender	Male	81.5	18.5
	Female	82.9	17.1

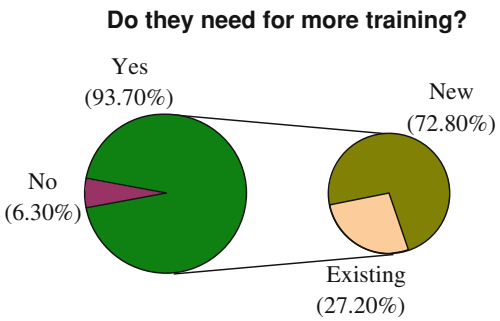

Fig. 6.3 The view of respondents on demand of further trainings

Table 6.6 List of the activities on which further training is demanded by the respondents

AIG trainings	Percentage of the respondents
Cattle	40.4
Fishery	6.6
Poultry	2.0
Nursery	8.3
Vegetable	11.3
Sewing	9.9
ICS	1.0
Eco-tour guide	3.0
Cooking	1.3
Cloth weaving	7.9
Bamboo-based enterprise	4.0
N/A	4.3
Total	100.0

community in the form of physical incentives for practicing agriculture. An average of 177.27 (SE, 9.40) decimal of such vacant lands were allotted to the FUG members in the neighboring communities of RKWS. The respondents living

inside the forest, having major stakes to the sanctuary, belonging to tribal community and being male were found to be allotted higher amount of lands such as 206.00 (SE, 48.07), 199.01 (SE, 14.30), 183.72 (SE, 18.05) and 189.07 (SE, 11.82) decimal, respectively. There were no significant differences in average landholdings of homestead, own agricultural lands and agricultural lands allotted by FD among the FUG members in terms of village position, village stake pattern and ethnicity except the gender of the respondents (Table 6.7). Significant differences were found at $p < 0.05$ significant level in the amount of land in all the three categories among the male and female respondents only.

Only a few (38.4 %) of the respondents reported that they used the high yielding variety in agriculture (Table 6.8). The intensity was found highest among the female respondents (45.7 %) followed by the *Bangalee* ethnic groups (42.2 %). A majority of the households (69.2 %) reported the collection of non-timber forest products (NTFPs) from the sanctuary as the supplement of their livelihoods. If considered category-wise, the frequency was found highest among the people living inside the forest and belonging to the tribal groups (Table 6.9).

6.4.2 Fuel Wood Consumption and Reduction in Its Collection

The respondents were reported to exclusively be dependent on fuel wood for household uses. Consumption of fuel wood in the community was 276.18 (SE, 10.21) kg month^{-1} household^{-1}. The respondents living outside the sanctuary were found to consume more fuel wood (283.11, SE 19.17) than others. If considered according to the stake level, respondents living in villages with major stake were found to consume more (284.09, SE 15.01). The *Bangalee* consumed more (289.86, SE 12.26) than the tribal and the female more (344.57, SE 25.07) than their male counterparts. A significant difference was found in the consumption of fuel wood among the respondents according to the ethnicity only.

A specific question was asked to the respondents whether there was any reduction in their collection of fuel wood after joining the FUG. In response, overall 61.9 % answered positive, 35.8 % negative and 2.3 % did not make any comment. The rate of reduction in collection was higher in respondents living adjacent to the sanctuary, with minor-medium stake, of the *Bangalee* ethnicity and being the male (Table 6.10).

Change in use pattern, i.e., shifting to alternative fuel rather than wood was reported as the most effective way (29.5 % of the respondents) of reduction in fuel wood collection followed by being more aware (16.6 %) and planting more trees in homegardens (16.2 %) (Table 6.11).

Table 6.7 Average landholdings of the respondents' family in and around RKWS

Category		Average landholdings (decimal)		
		Homestead	Agro-land of own	Agro-land allotted from FD
Overall		24.26 (SE, 1.09)	11.58 (SE, 2.19)	177.27 (SE, 9.40)
Village position	Inside	21.00 (SE, 4.79)[a]	–	206.00 (SE, 48.07)[a]
	Adjacent	25.34 (SE, 1.46)[a]	11.54 (SE, 3.08)[a]	194.44 (SE, 12.90)[a]
	Outside	23.32 (SE, 1.73)[a]	13.37 (SE, 3.54)[a]	150.23 (SE, 13.86)[a]
Village stake	Major	26.15 (SE, 1.70)[a]	11.51 (SE, 3.41)[a]	199.01 (SE, 14.30)[a]
	Medium	22.23 (SE, 2.04)[a]	12.14 (SE, 4.32)[a]	174.95 (SE, 19.93)[a]
	Minor-medium	23.39 (SE, 2.18)[a]	13.46 (SE, 4.52)[a]	148.19 (SE, 17.06)[a]
	Minor	24.47 (SE, 4.59)[a]	–	146.40 (SE, 21.50)[a]
Ethnicity	Bangalee	23.87 (SE, 1.23)[a]	12.58 (SE, 2.60)[a]	175.74 (SE, 10.83)[a]
	Tribe	25.93 (SE, 2.35)[a]	7.45 (SE, 3.28)[a]	183.72 (SE, 18.05)[a]
Gender	Male	25.49 (SE, 1.34)[a]	8.1842 (SE, 2.41)[a]	189.07 (SE, 11.82)[a]
	Female	20.20 (SE, 1.47)[b]	22.63 (SE, 4.81)[b]	138.17 (SE, 9.26)[b]

SE means the standard error

[a,b] Stand for indicating the levels of significant difference at the $p < 0.05$ significant level; similar letters indicate 'no significant difference' and dissimilar letters indicate 'significant difference'

Table 6.8 Practice of using high yielding variety (HYV) in agriculture

Category		Frequency (%)	
		Yes	No
Overall		38.4	61.6
Village position	Inside	11.1	88.9
	Adjacent	41.4	58.6
	Outside	38.5	61.5
Village stake	Major	40.9	59.1
	Medium	36.4	63.6
	Minor-medium	40.3	59.7
	Minor	20.0	80.0
Ethnicity	*Bangalee*	42.2	57.8
	Tribe	22.4	77.6
Gender	Male	36.2	63.8
	Female	45.7	54.3

Table 6.9 Do the respondents collect non-timber forest products from the forest?

Category		Frequency (%)	
		Yes	No
Overall		69.2	30.8
Village position	Inside	100	–
	Adjacent	69.1	30.9
	Outside	64.8	35.2
Village stake	Major	70.1	29.9
	Medium	68.2	31.8
	Minor-medium	62.5	37.5
	Minor	42.7	57.3
Ethnicity	Bangalee	62.3	37.7
	Tribe	98.3	1.7
Gender	Male	68.1	31.9
	Female	72.9	27.1

6.5 Financial Capital

6.5.1 Change in Occupation

A remarkable change in the respondents' occupation for securing livelihoods was noticed in the community. Before joining the FUG, the highest proportion of the community members (27.5 %) earned their livelihoods by the profession of day labor followed by forest product collection (27.2 %), agriculture/farming (22.8 %), illegal wood cutting (7.6 %), and so on (Fig. 6.4). But presently, most of them (72.8 %) were found to be involved in agriculture/farming that includes a variety of activities like cultivating agricultural crops, vegetable gardening, cattle rearing, poultry farming, pig rearing, fishery, fruit cultivation etc. Illegal wood cutting and its sale in the market was also a livelihood strategy before which, in the

Table 6.10 Fuel wood consumption and reduction in its collection by the community in and around RKWS

Category		Amount consumed (kg month^{-1} household^{-1})	Reduction in fuel wood collection after joining FUG (%)		
			Yes	No	No comment
Overall		276.18 (SE, 10.21)	61.9	35.8	2.3
Village Position	Inside	194.44 (SE, 14.82)a	44.4	55.6	–
	Adjacent	280.03 (SE, 12.16)a	63.6	35.8	0.6
	Outside	283.11 (SE, 19.17)a	62.3	32.8	4.9
Village Stake	Major	284.09 (SE, 15.01)a	63.8	35.4	0.8
	Medium	277.39 (SE, 19.66)a	58.0	37.5	4.5
	Minor-medium	274.38 (SE, 23.44)a	65.3	31.9	2.8
	Minor	210.67 (SE, 11.48)a	53.3	46.7	–
Ethnicity	Bangalee	289.86 (SE, 12.26)a	66.8	30.3	2.9
	Tribe	218.62 (SE, 9.83)b	41.4	58.6	–
Gender	Male	266.85 (SE, 12.50)a	65.1	31.9	3.0
	Female	344.57 (SE, 25.07)a	51.4	48.6	–

SE means the standard error
[a, b] Stand for indicating the levels of significant difference at the $p < 0.05$ significant level; similar letters indicate 'no significant difference' and dissimilar letters indicate 'significant difference'

Table 6.11 Ways of reduction in fuel wood collection from forest by the community after joining the FUG in the study area

Category		Ways of reduction in fuel wood collection (%)			
		Planting more trees in homegardens	Changing in use pattern (e.g., wood to leaf, agro-residues etc.)	By being more aware	N/A
Overall		16.2	29.5	16.6	37.7
Village Position	Inside	16.7	27.8	–	55.6
	Adjacent	14.8	32.7	16.7	35.8
	Outside	18.0	25.4	18.9	37.7
Village Stake	Major	15.7	32.3	16.5	35.4
	Medium	13.6	28.4	15.9	42.0
	Minor-medium	20.8	25.0	19.4	34.7
	Minor	13.3	33.3	6.7	46.7
Ethnicity	Bangalee	18.4	29.5	19.3	32.8
	Tribal	6.9	29.3	5.2	58.6
Gender	Male	19.4	33.2	12.9	34.5
	Female	5.7	17.1	28.6	48.6

changed situation, has been replaced with establishing plant nursery for seedling sale (Table 6.12). The category 'others' include a variety of such other livelihood mechanisms as cloth weaving, handicrafts making, lower level office worker,

Fig. 6.4 Illegal wood cutting was a significant source of income by the community

Table 6.12 Changing pattern in the respondents' occupation for sustaining livelihoods

Occupations before joining the FUG	Relative frequency (%)	Present occupations	Relative frequency (%)
Day labor	27.5	Agriculture/ farming	72.8
Forest product collection	27.2	Small business	8.9
Agriculture/farming	22.8	Plant nursery	7.0
Illegal wood cutting	7.6	Day labor	5.0
Nothing	7.0	Housewife	4.6
House wife	3.6	Eco-tour guide	1.0
Small business	3.3	Others	0.7
Others	1.0		

herbal practitioner, barber and middleman in various local businesses. A pictorial view of diversified occupations of the community is shown in Figs. 6.5, 6.6, and 6.7. The accessibility to micro-credit facility was insignificant in the study area as only about 15 % of the respondents (Table 6.13) reported the receiving of micro-credits from few NGOs like *Grameen Bank*, *BRAC* and *Proshika*.

6.5.2 Increase in Annual Income

An increase in the average annual income was seen in the community. Before joining the FUG, their average annual income was Tk. 25812.91 (SE, 756.14), which was increased to Tk. 43517.88 (SE, 1203.35) after joining the FUG. It was increased as much as by 68.56 %. If considered category-wise, the highest increase in average annual income was found in the respondents with major stake (Fig. 6.8), while the highest percentage increase was in the respondents living adjacent to the sanctuary (Fig. 6.9). Overall, about 40 % of the respondents were revealed as economically solvent, 48 % short-term insolvent, 9 % long-term

Fig. 6.5 Both the *Bangalee* and tribal communities are involved in bamboo-based handicrafts manufacturing

Fig. 6.6 Weaving cloths in traditional way, revived as the occupation of the *Tripura* ethnic communities

insolvent and 3 % with surplus economic condition. No household with surplus economy was found in the communities living inside the sanctuary, having minor stake to it and belonging to the tribal group (Table 6.14).

In order to check whether there is any significant change in the average annual income of the respondents before and after joining the FUG, and whether the allotment of agricultural land by the FD is significantly contributing to the increase

Fig. 6.7 Plant nursery became a popular and profitable occupation presently

Table 6.13 Status of micro-credit received by the respondents

Category		Frequency (%)	
		Yes	No
Overall		14.9	85.1
Village position	Inside	–	100
	Adjacent	16.0	84.0
	Outside	15.6	83.5
Village stake	Major	16.5	83.5
	Medium	12.5	87.5
	Minor-medium	18.1	81.9
	Minor	–	100
Ethnicity	*Bangalee*	18.0	82.0
	Tribe	1.7	98.3
Gender	Male	12.1	87.9
	Female	24.3	75.7

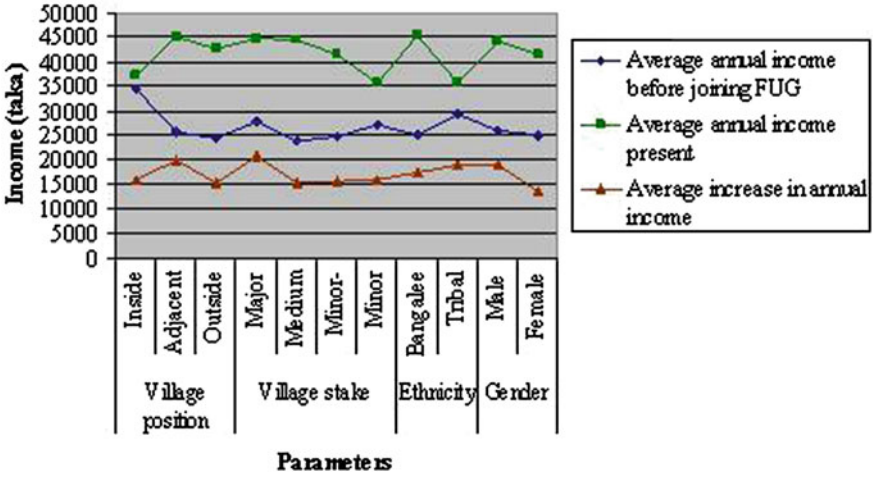

Fig. 6.8 Respondents' average annual income before and after joining the FUG

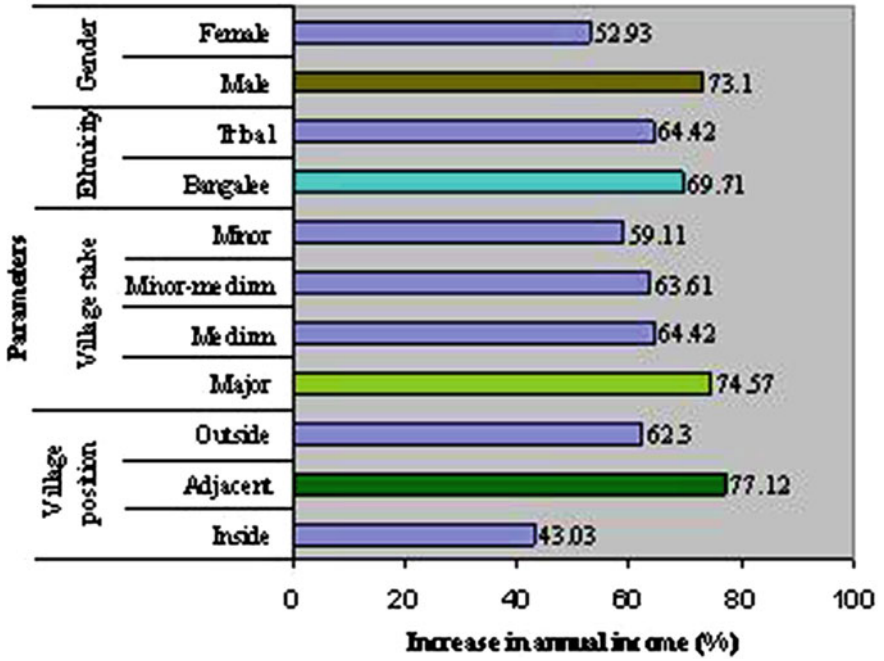

Fig. 6.9 The percentage increase in the respondents' average annual income

Table 6.14 Solvency status of the respondents

Category		Relative frequency of respondents (%)			
		Solvent	Surplus	Short- term insolvent	Long-term insolvent
Overall		39.7	3.3	48.3	8.6
Village position	Inside	27.8	–	44.4	27.8
	Adjacent	43.8	3.7	48.1	4.3
	Outside	36.1	3.3	49.2	11.5
Village stake	Major	43.3	3.9	47.2	5.5
	Medium	38.6	2.3	50.0	9.1
	Minor-medium	37.5	4.2	47.2	11.1
	Minor	26.7	–	53.3	20.0
Ethnicity	Bangalee	40.2	4.1	48.8	7.0
	Tribe	37.9	–	46.6	15.5
Gender	Male	38.8	3.4	47.8	9.9
	Female	42.9	2.9	50.0	4.3

in annual income; paired t-test has been conducted. Two null hypotheses have been postulated as

Ho1 There is no significant difference between the respondents' present annual income to the annual income before joining the FUG and

Table 6.15 Paired T-test for respondents' present annual income to the annual income before joining FUG

Parameters	df	Mean	Std. dev.	Std. error	Paired differences					t	Sig. (2-tailed)
					Mean	Std. dev.	Std. error	95 % Confidence interval of the difference			
								Lower	Upper		
Annual income before	301	25812.91	13140.40	756.14	17704.97	14917.91	858.43	19394.25	16015.68	20.625	0.000
Annual income present		43517.88	20912.06	1203.35							

Table 6.16 Paired T-test for increase in respondents' annual income to the land leased from the FD

Parameters	df	Mean	Std. dev.	Std. error	Paired differences					t	Sig. (2-tailed)
					Mean	Std. dev.	Std. error	95 % confidence interval of the difference			
								Lower	Upper		
Increase in average annual income	301	17698.34	14904.41	857.65	17521.11	14866.51	855.47	15837.64	19204.57	–20.481	0.000
Agricultural land allotted by FD		177.27	163.38	9.40							

Ho2 There is no contribution of the amount of agricultural land allotted by the FD to the increases in the respondents' annual income.

In both the cases, significant differences have been found both at $p < 0.05$ and $p < 0.01$ significance levels (Tables 6.15 and 6.16). It depicts that the null hypotheses postulated above are not accepted.

6.6 Social Capital

6.6.1 Progress in Socio-cultural Parameters

During the survey, a progress in various socio-cultural parameters was seen in the community. They, now get more invitation in various social ceremonies like wedding, rituals and other social observances (87.4 % interviewee responded affirmative); more importance from the Forest Department staffs (45.7 %); more respect from the family members (99 %); more help from the neighbors in case of emergency and troubles (75.8 %) than any other time before joining the FUG. About 16 % of the respondents reported that they have the recreation access in terms of television, radio and other amusement now that they neither owned nor enjoyed before; the other 84 % were found still deprived of this service. About 23 % of the respondents reported that accessibility in general service provider institutions like bank and units of local administration became easier to them after involving in the project activities by joining the FUG. Most of the members of the community (82.1 %) were found to make decision combined with their spouse or family, a few (11.3 %) themselves while a very few (6.6 %) have no contribution in this regard. Three specific questions were asked to the female respondents regarding the reduction in tease by others when they go outside the home, torture by their husbands and demand for dowry by their husbands and or husbands' family. A remarkable reduction was reported in all these three parameters among the female participants in the community. Detail results of social progress in different categories of the respondents are presented in Tables 6.17 and 6.18.

6.6.2 Willingness to Continue the Membership in FUG

Finally we asked the respondents a very specific question of their willingness for continuing the membership in FUG (Fig. 6.10). In response, all of them expressed a firm determination to continue it. 'Economic benefit' ranked the highest position in their opinion (46.7 %) as the reason for their will to cling on the FUG as a

Table 6.17 Improvement of the community in terms of social parameters in the study area

Parameters	Relative frequency of the respondents (%)											
	Overall	Village position			Village stake				Ethnicity		Gender	
		Inside	Adjacent	Outside	Major	Medium	Minor-medium	Minor	Bangalee	Tribe	Male	Female
Do you get more invitation in social ceremony than before?												
Yes	87.4	77.8	91.4	83.6	92.1	84.1	87.5	66.7	88.5	82.8	83.6	100
No	12.6	22.2	8.6	16.4	7.9	15.9	12.5	33.3	11.5	17.2	16.4	–
Do you get more importance from the FD than before?												
Yes	45.7	16.7	46.9	48.4	46.5	45.5	51.4	13.3	50.8	24.1	42.7	55.7
No	32.8	50.0	32.1	31.1	29.9	37.5	27.8	53.3	29.1	48.3	34.5	27.1
No comment	21.5	33.3	21.0	20.5	23.6	17.0	20.8	33.3	20.1	27.6	22.8	17.1
Do you get more respect from the family members than before?												
Yes	99.0	100	98.8	99.2	99.2	98.9	98.6	100.0	99.2	98.3	100	95.7
No	1.0	–	1.2	0.8	0.8	1.1	1.4	–	0.8	1.7	–	4.3
Do you have the recreation access (TV, radio etc.) now that you did not have before?												
Yes	15.9	–	16.7	17.2	16.5	14.8	18.1	6.7	18.4	5.2	13.4	24.3
No	84.1	100	83.3	82.8	83.5	85.2	81.9	93.3	81.6	94.8	86.6	75.7
Do you have easier access to banks and local administration than before?												
Yes	22.8	5.6	22.2	26.2	22.8	20.5	29.2	6.7	26.6	6.9	22.8	22.9
No	77.2	94.4	77.8	73.8	77.2	79.5	70.8	93.3	73.4	93.1	77.2	77.1
Do you get help more from others in case of troubles than before?												
Yes	75.8	83.3	75.9	74.6	74.0	79.5	70.8	93.3	74.6	81.0	78.9	65.7
No	24.2	16.7	24.1	25.4	26.0	20.5	29.2	6.7	25.4	19.0	21.1	34.3
How do you make decision?												
Own only	11.3	5.6	11.1	12.3	11.0	12.5	11.1	6.7	11.9	8.6	12.1	8.6
Combined with spouse or family	82.1	83.3	81.5	82.8	81.9	80.7	81.9	93.3	82.8	79.3	87.9	62.9
No contribution	6.6	11.1	7.4	4.9	7.1	6.8	6.9	–	5.3	12.1	–	28.6

Table 6.18 Is there reduction in some social problems (female respondents only)

Category		Reduction of tease when go outside of home (%)		Reduction of torture by husband (%)		Reduction of demanding dowry by husband (%)	
		Yes	No	Yes	No	Yes	No
Overall		97.1	2.9	92.9	7.1	87.1	12.9
Village Position	Inside	100	–	50.0	50.0	100.0	–
	Adjacent	95.3	4.7	93.0	7.0	83.7	16.3
	Outside	100	–	96.0	4.0	92.0	8.0
Village Stake	Major	96.7	3.3	93.3	6.7	86.7	13.3
	Medium	95.7	4.3	91.3	8.7	82.6	17.4
	Minor-medium	100.0	–	94.1	5.9	94.1	5.9
	Minor	–	–	–	–	–	–
Ethnicity	Bangalee	96.5	3.5	93.0	7.0	84.2	15.8
	Tribal	100	–	92.3	7.7	100.0	–

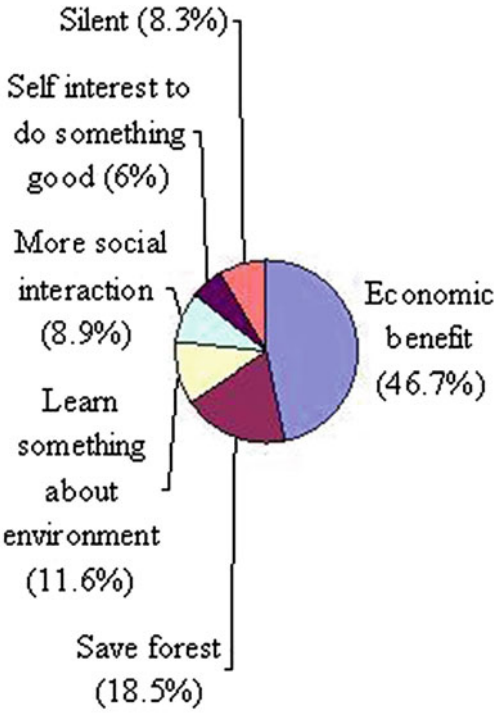

Fig. 6.10 Reasons for respondents' continuing the membership in the FUG

continuous process. It was followed by 'saving the forest' (18.5 %), 'learning something about environment' (11.6 %), 'more social interaction' (8.9 %) and 'self-interest to do something' (6 %). A few of them (8.3 %) did not give any answer in response of this question.

6.7 Discussion and Conclusion

Around the world people's participation in protected areas has been built around a vision for human empowerment, advancement and welfare with the fullest range of available natural resources as an integral part (Mbie et al. 2005). Campbell et al. (2008) stated that the benefits of protected areas for local communities can include direct revenue from environmental protection, livelihood diversification, security of access to given resources and the maintenance of ecosystem services such as watershed protection. On the other hand, Maharjan et al. (2009) opined that health, food security, education, and capacity building are key indicators of human capital. The present study revealed the existence of livelihood diversification in the form of AIG activities that led to community advancement in the vicinity of Rema-Kalenga Wildlife Sanctuary. The FUG members were given training on a total of 12 AIG activities after adopting which a positive change has been occurred in their economic condition. Before, most of the community members were poor or ultra-poor (almost 90 % of them) and depended on the sanctuary for livelihoods. They used to earn subsistence money either by collecting NTFPs unsustainably or cutting timbers illegally thus accelerating the forest degradation. After the project activities has been started, they left stealing timber from the sanctuary as the primary profession and most of them became the growers of plants either in the form of agriculture or as the suppliers of tree seedlings by establishing plant nursery. There lies the success of the Forest Department who could divert some people radically from their role of tree destroyers to tree growers. People could see the direct benefits of their participation in the conservation project that discouraged them to further involve in destructive activities, rather encouraged to engage in conservation mission. This attitudinal change has been happened in the community because of the project's provision of the incentives to its participants. The provision of incentives was in the form of AIG training and agricultural land allotment to the community. Moreover, traditional collection of various NTFPs from the sanctuary also acts as the informal incentive to the community. The people use to collect edible and medicinal plants, raw materials for handicrafts and other utensils and feeds for livestock from the forests. Although there is no official permit to harvest these resources, a tacit approval from the management authority exists. In general, incentives bring the success to co-management which is evident from the situation of other parts of the world too. The rehabilitation project of degraded forests in Ghana enjoyed a high participation rate with the local people showing profound interest in the future of the project activities and are taken to invest their own resources, time, money and labor in the rehabilitation activities. This is because the whole project approach was community-led and appropriate incentives (e.g., provision of farming lands, agricultural inputs, extension services, grants and domestication of small animals for food and income etc.) were used (Blay et al. 2008). In Nepal, forest resources in most regions were deteriorating before the introduction of community forestry by FUGs, whereas the forests there are now improving where community forestry is well established (Yadav et al. 2003).

Although Blaint (2006) claimed that community-based projects improve conditions for local residents, alleviate pressures on reserves, and reduce conflicts between community members and park managers in principle; however, both conservation and development outcomes often fall below expectations in practice. But our experience suggests that the conservation goals will be achieved if proper problems of the community are addressed and adequate incentives are given to them. It was well evident from the community's reduction in the collection of fuel wood from the sanctuary. Mukul and Quazi (2009) also reported on majority of female FUG members' leaving the profession of fuel wood collection after their involvement in co-management activities in Satchari National Park, Bangladesh. Actually, protected areas in Bangladesh and elsewhere are used by local people who not only collect fallen limbs and twigs for fuel wood, but also cut immature trees, which is described as unsustainable harvesting leading to environmental degradation (Quazi et al. 2008). But curbing the collection of fuel wood may create an ethical dilemma because many local people depend on it to meet their energy needs, the most important of which is cooking. Therefore, what is important in this critical situation is to take measures for the reduction in collection. It can be done in a variety of way as seen in the study area- adopting other alternative fuel like agricultural residues, cow-dung, tree leaves etc. along with wood; being more aware of the fuel wastage during cooking and planting more trees around the homesteads. Again, using agricultural residues, cow-dung and tree leaves may raise question of the problems of the flow of organic nutrients in agriculture and forest soils. In that perspective, there is no other alternative than increasing plant resources by planting more trees when almost all the people in the community use traditional mud stoves that do not support using other fuels. Nevertheless, the reduction in the respondents' collection of fuel wood depicts that less pressure has been exerted to the forests that results in the increase of stock in the sanctuary. This is an indirect impact. Moreover, planting trees in homegardens as a strategy of reducing wild collection of fuel wood also ensures the increase in the floristic stock in the region, even though it is in a lesser amount. This can obviously be considered as the advancement in the conservation status in and around the sanctuary.

Development in socio-cultural factors, termed as the social capital, plays an important role in the management of natural resources and improvement of livelihoods, especially in the remote places and rural areas (Nath and Inoue 2010). In that sense, in our study area, the inspiring progress in various socio-cultural parameters of the community seems to form the basis of sound management of the sanctuary. Analysis of the foundation of community-based regimes in developing countries has already shown that local institutional arrangements including customs and social convention designed to induce cooperative solutions can overcome the problems of collective action and help achieve efficiency in the use and management of natural resources (Adhikari et al. 2007). Not only in the developing countries, has this approach makes some sort of social impacts in developed societies also. For instance, in the collaborative watershed management in Ohio, USA, social outputs have been centered on educating land owners about watershed

conservation and potential donors about the importance of raising funds for land preservation (Hardy and Koontz, 2010). Nevertheless, the important finding of the present study was the change in the attitude of the Forest Department staffs towards the local people. Muhammed et al. (2008) claimed that as the implementing agency of any project, mostly the staffs of this public institution used to play the key role in the failure of the project in most cases before. Because their attitude was not one that could seek active inclusion of genuinely poor people and other direct stakeholders in the forestry projects. Tole (2010) also conceded that state officials entrusted with the design and implementation of co-management projects in many developing societies, often have negative attitudes about community empowerment, which impedes the full realization of the project goals. Nonetheless, in our study area, now a change, although in small-scale, has been observed in the study area in this regard. Another remarkable progress was noticed in some socio-cultural parameters relating to the female members of the community. Women are generally recognized to play a significant role in resource management because of their diverse skills, knowledge and experiences, which are different from those of men (Brown and Switzer 1992). Unfortunately, in most of the rural areas of Bangladesh, women are deprived of status and respect in both their family environment and the large society (Subhani 2008). But with this co-management project, the Forest Department allowed and encouraged the women to participate actively in the project activities that resulted in the improvement of their empowerment and reduction in physical and mental harassments both in family and society levels.

The community members were found very eager to contribute to the conservation efforts by continuing their membership in the FUGs. They reported five different reasons for their willingness to be involved in co-management process. Receiving the direct benefit economically inspired them as the proper incentive for participation. The finding was supported by Shewly (2008) referring the communities around Lawachara National Park of the country where nearly half of the women earn the income independently since their participation in co-management, who further categorized saving money and preserving biodiversity as the top two reasons for joining FUG. The similar trend was also found in the local communities in four villages around Serengeti National Park, Tanzania who mentioned continued benefits and employment opportunity as two prominent reasons of their involvement in biodiversity conservation activities (Kideghesho and Mtoni 2008). Usually, with the provision of proper incentives, people become more willing to participate in every day management activities, accept the rules and regulations governing access and harvesting, and the overall system then becomes effective as the community gets truly involved and benefitted (Adhikari et al. 2007). Ultimately, this improves the chances of long term success for co-management, resulting in continued improvements in forest health and the overall environmental situation, as well as the livelihoods of the people involved. Adhikari and colleagues also mentioned that as the participation and involvement of the whole community is essential to the success of co-management, it is important that the majority of the community feel that they are benefiting from it. On the contrary, as

assessed by Rodgers et al. (2002), communities will be reluctant to participate fully in co-management unless they receive adequate benefits or returns as an incentive to conserve.

Despite the demonstration of quite a few upbeat impacts of co-management project both on the forest conservation and community development in the study area, there are still a number of bottlenecks in the process. These came out from the Focus Group Discussion (FGD) with the community members. Presently training on AIG activities did not fully reflect the exact needs of the society in some cases. Pig rearing is such a program that was viewed less profitable than cattle rearing and there was a strong opinion in favor of the latter. It was seen that training on pig rearing was launched targeting the tribal people of the community who not form really a considerable portions there. Since the community is dominated by the *Bangalee* ethnicity, most of who are Muslim by religion and religiously they do not have the provision to keep pork in the food habit, the tribal face the difficulty in marketing their pig products. Moreover, the tribal people themselves are not in that much economically well-off position that they can buy all the pigs produced in the community. Therefore, choosing need-based AIG options for the community becomes crucial day by day. The local community is informally dependent on medicinal plants for general healthcare and there are few species, parts of which are collected commercially (Chowdhury and Koike 2010b). Therefore, homestead- and buffer zone-based commercial cultivation of locally grown widely demanded medicinal plants could be a potential option of alternative livelihoods and it was strongly reflected in the FGD. Moreover, creating the opportunities for more forest-based income generating enterprises would be viewed location-specific and culturally compatible as the community has the long-time acquaintance with the forested setting. In Uganda, development of such enterprises as a strategy of co-management improved the livelihoods of local community while protecting natural resources in Bwindi Impenetrable National Park (Mujuni et al. 2003). The people in FGD also complained about the uneven distribution of AIG support among the co-management partners. There are a small number of high-interest groups in the community as elsewhere, and the Forest Department staffs were accused of focusing and emphasizing them heavily while distributing the training on AIG. There are some people who received trainings in more than one strategy and still there are some who did not get even a single. This is a 'red flag' suggesting a lack of equity in the access of incentives. Hence, this issue is to address acutely to ensure the real representation of the key stakeholders and maintain the social equity. The matter of accountability and misbehavior of the Co-management Committee was reported as another problem by the community that needs to be addressed by the authority. The similar kind of problem was also reported by Zulu (2008) in the village forest committees in Malawi. The female participants of the FGD informed that although the current situation is better than before but still they face difficulties in case of their active involvement in project activities. Actually, in Bangladesh, local socio-cultural values and gender norms are very strong, particularly in remote rural areas, so any new interventions from the outside are often treated skeptically or negatively. As a

result, women from forest villages often fail to realize long-term positive impacts for their livelihoods (Subhani 2008). Therefore, more awareness programs should be taken to maintain gender balance and equality for meeting the major ethics of this type of program.

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Chapter 7
Assessment of the Community Participation in and Attitudes Towards Co-management Programs in Rema-Kalenga Wildlife Sanctuary

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Abstract This chapter analyzes the extent of local participation in the co-management activities of Rema-Kalenga Wildlife Sanctuary, Bangladesh and the local communities' attitude towards it. The study showed that there is the participation of local Forest User Groups in different stages of the program, but in varying degrees, mostly dominated by passive way. All the respondents had the knowledge about the goal of the ongoing co-management project. Majority (about 82 %) of them had access on the trainings on livelihood options although they had no contribution on its choice. It resulted in the divergence between the right needs and the trainings received. Although a considerable portion of the community (76.2 %) had the freedom to express their opinion in the monthly meeting with the project authority, only a few (36.1 %) of them thought that their opinions/suggestions were valued properly. However, almost all the respondents (91.7 %) expressed their satisfaction with the activities of the Forest Department, the project implementation authority. Although a varying level of attitude was noticed on various perceptions, overall a favorable attitude of the respondents was explored. Attitudes also varied according to the respondents' categories based on village position, village stake level, ethnicity and gender. Increase in annual income resulted from the augmented skills by trainings on AIG activities, and getting agricultural lands leased from the Forest Department contributed significantly to the variation in respondents' conservation attitudes. It is suggested that eliminating inequity and inequality in incentive

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M. S. H. Chowdhury (ed.), *Forest Conservation in Protected Areas of Bangladesh*, World Forests 20, DOI: 10.1007/978-3-319-08147-2_7,

distribution, discovering and launching training on more need-based livelihood activities, and liberalizing the restriction of resource extraction by fixing the harvesting limit would encourage the community to involve more cordially in the conservation efforts of the sanctuary. For the local participation to really work, it is recommended that long-term relationships, faiths and commitments are required between both parties: the community and outside agents.

7.1 Introduction

For the forest restoration and rehabilitation projects to be successful, the involvement of motivated local communities is inevitable (Blay et al. 2008). This participation is considered as one of the most essential principles in such local level development projects (OECD 1985). In forestry, participatory programs can be defined as full participation of stakeholders in forestry decisions from policy formulation to field-level execution and back (Warner 2003). Participatory approaches can be defined as institutional settings where actors with an interest in as issue, but external to the formal politico-administrative cycle 'are brought together to participate, more or less directly, and more or less formally, in some stage of the decision-making' (van den Hove 2000). Participatory forestry program is regarded as an umbrella concept covering all of the different types of forestry activities that involve local stakeholders, especially villagers, in different degrees of decision-making authority (Potters et al. 2003). The involvement of local communities, local governments, and other stakeholders (including the private sector, NGOs, and international agencies) has now been accepted as an ongoing trend in forest management (Warner 2003). Rodela and Udovo (2008) informed that the contention that the local population, and other stakeholder groups, should be involved at some stage in the establishment of a protected area, and in its further planning, is relatively new and is partially connected to critiques addressing conservation-led displacement, natural resource conflict and issues of social justice. But West et al. (2006) commented that participation in protected area management, can improve people-park collaboration, and contribute to the understanding of local issues and knowledge sharing.

Participation in forestry programs is often associated with a process of decentralization, which empowers local government and local agency representatives. In Tanzania, for instance, previously dormant Village Natural Resource Committees have been reinvigorated by community-based forest management and joint forest management initiatives, engaging in negotiations with the Forest and Beekeeping Division and- where forest are used by several communities- with other committees. In Nepal, decision-space opened up by the organization of a national user-group federation has greatly increased the bargaining power of community forestry groups and led to significant policy changes (McDermott and Schreckenberg 2009). Decentralized participatory conservation draws heavily from two principles:

subsidiary and collective action. The subsidiary principle advocates that the decision-making power for tasks more appropriately undertaken at the local level should be devolved to local communities without adverse effects to central policies (Krishna 2003). The collective action principle asserts that accountable mobilization of resources by local communities prevents free-riding and fosters sustainability (Ostrom 1990). With regard to the concept of public participation, documents, policy reports and articles show a divergence of positions. Some would suggest that participation is a setting where policy decisions are presented to, and discussed with, stakeholder groups or the citizenry. Others would suggest that it is a setting where stakeholder groups, or the citizenry, are involved from the very beginning and have an influence on the policy outcomes. The first group belongs to the policy-making sphere, while the second group is closer to civil society. In other words, there seems to be a disjunction on the question of power distribution and access to the decision-making process (Rodela and Udovo 2008). The power distribution between involved actors in a co-management arrangement can better be understood from the ladder of co-management shown in Table 7.1.

Promotion and implementation of 'bottom–up' approach as the locally derived, grass-root strategies, including participatory forestry management, co-management of protected areas and forestry and environmental education, are likely to have a positive impact on the future of forest resources of a country (Muhammed et al. 2008). Gonzalez et al. (2006) studied a small community-based organization in the mountains of Puerto Rico and found that their bottom-up planning strategies were effective. In Romania, during the establishment of the Goricko Landscape Park, a comprehensive participatory 'bottom-up' package constituting of focus groups, workshops, consultations and public forums was implemented (Desnik 2004). The successful implementation of the field initiatives of the community-based forest rehabilitation project in Ghana was in no doubt a direct result of the process of communication or consultation, characterized by arrangements that involved various degrees of authority and responsibility being shared between stakeholders (Blay et al. 2008). One of the important purposes of the Little Hogback Community Forest Project in the northeastern U.S. was to better incorporate forestry and land conservation into the community by providing meaningful opportunities for more people to participate, benefit and care about their forests (Brighton 2009). To attain the success in such approaches, Ostrom (2005) emphasized on the establishment of a robust or a viable and stable co-management regime between the actors; and it can further be ensured if the institutional arrangements are characterized by the eight design principles as presented in Table 7.2.

Schreckenberg and Luttrell (2009) clarified the definition of participatory forestry as 'it refers to processes and mechanisms that enable those people who have a direct stake in forest resources to be part of decision-making in some or all aspects of forest management, from managing resources to formulating and implementing institutional frameworks'. This is the FAO definition of participatory forestry with a minor modification (see the italics) to recognize the fact that participation in some forms of participatory forest management is limited to some, rather than all, aspects of forest management (Schreckenberg and Luttrell 2009).

Table 7.1 Ladder of co-management (mentioned from *bottom* to *top*) (adapted from Berkes 1994)

7	Partnership	Partnership as equals; joint formal, institutionalized decision-making
6	Management boards	Local actors are given the opportunity to participate in developing and implementing plans and input plays more than just an advisory role
5	Co-operation	Local actors have input into management and local knowledge is solicited; community members are involved at a low level as assistants or guides, still limited by management agencies
4	Advisory committees	Partnership in decision-making starts, joint actions on common objectives and local actors have an advisory role only; decisions are non-binding
3	Communication	Start of two-way information exchange; local concerns begin to enter management plans, joint management actions may take place without joint jurisdiction over the resource
2	Dialogue	Start of face-to-face contact, local actors' input is heard but not necessarily heeded (usually involved late in the decision-making process); limitation of involvement continues to be set by the government agency
1	Informing	Local actors are informed about decisions already made, one-way communication between and the community

Table 7.2 Design principles for viable and stable co-management regimes (adapted from Ostrom 2005)

1	Clear boundaries	The boundaries of resources and user groups with right to withdraw resource units from the common pool resource are clearly defined
2	Correspondence between benefits and costs	Allocation rules are related to local conditions
3	Collective choice	Most individuals affected by the operational rules can participate in modifying the operational rules
4	Monitoring	Accountability mechanisms for monitors are devised
5	Gradual sanctions	Graduated sanctions are applied to appropriators that deviate from the regime
6	Conflict resolution mechanisms	Low cost, local conflict resolution mechanism is used to resolve conflicts among appropriators
7	Rights to organize	Users have the right to organize and to make autonomous decisions
8	Multi-level governance	Authority is allocated to allow for adaptive governance at multiple levels from local to global level

Unfortunately, local people are still in many cases not actively or genuinely involved in development projects in the sense that project initiators remain the main decision makers and literally give advice to farmers on what to do (Borrini-Feyerabend 1996). This attitude has proved over and over again to have resulted in project failure and unsuccessful partnerships in forest management (Fisher 1995).

Protected areas not only provide the 'ecosystem services', but also meet the needs of local communities who live in and around them (Suckall et al. 2009). Although protected areas have usually been set aside from human exploitation, it is now increasingly recognized that they should play a role in sustaining livelihood of

adjacent local communities (Charnley et al. 2007). Local people, especially those living in and around protected areas, have important and long-standing relationships with these areas. Their needs, aspirations and attitudes should be considered in protected area management. Otherwise, the long-term survival of protected areas will be jeopardized (McNeely 1990). It is common that the conservationists have ignored traditional exploitation as a way to conserve biological diversity, preferring instead to protect natural systems by excluding people from parks and reserves and in doing so, denying them access to vital natural resources (Dolisca et al. 2007). The key feature of this strategy is that local community resource use is assumed to conflict with conservation (Weeks and Packard 1997). The conflicts between the authority of conservation areas and the local people are often a result of a disconnection between the conservation regulations and local conditions (Ostrom 1990). Protected area managers have traditionally relied upon law enforcement techniques to resolve conflicts with local people but in many cases, these techniques seemed to be insufficient and inappropriate (Sharma 1990; Newman et al. 1993). Therefore, alternative approaches to reduce the conflicts needed to be developed that provide tangible benefits to local communities and empower local people to manage natural resources (Newman et al. 1993). McNeely (1990) commented that the long-term protection of environmentally sensitive areas is threatened if people living in and around protected areas are ignored. For example, Trakolis (2001) describes how, during the establishment of the Prespes Lakes National Park in Greece, a top-down decision making process excluded the local community. As a result, conflicts arose with the local people resenting the imposition of the national park. The long-term survival of protected areas in developing nations will be jeopardized if needs, aspirations and attitudes of local people are not accounted for (Mehta and Heinen 2001). In such circumstances, Zube and Busch (1990) informed about the realization by the park authorities that local populations can no longer be ignored in the establishment, planning and management of protected areas, whether in developing or developed countries. In order to improve protected area management, perceptions and attitudes of the participants need to be studied, which, as Sewell (1973) pointed out, will offer much promise and help to identify the problems and to recognize potential solutions for developing appropriate strategy. Also, the outcome of decision-making is affected considerably by the perceptions and attitudes of participants in the process (White 1966).

Indeed, communities whose livelihoods chiefly involve the direct exploitation of local natural resources often come into conflict with the institutions of protected area, which are primarily designated for natural resource conservation or preservation (Anthony 2007). The general theme is that local people's perceptions of protected areas depend on their perceived cost and benefit from protected areas, their dependence on local resources, and their knowledge about protected area management. Because local people are not homogenous and do not share common norms, their interests and resource use patterns vary greatly at both the individual and household level (Xu et al. 2006). Disregarding their diversity would cause detrimental effects to local people and hinder the achievement of conservation and management objectives (Agrawal and Gibson 1999; Geoghegan and Renard 2002).

Therefore, managers and planners of protected areas are required to identify and understand the different interests of individuals, assess their dynamics, and integrate the pertinent information into protected area management. There is growing empirical evidence indicating that assessment of local responses toward protected areas is a crucial step in gathering information that can be incorporated into decision-making processes and lead to people-park conflict mitigation (Jim et al. 2002; Rao et al. 2003). Indeed, local communities' perceptions of protected areas influence the kinds of interactions people have with them, and thereby conservation effectiveness (Allendorf et al. 2006). Their perceptions of protected areas management play also an important role in their attitudes toward them (Allendorf et al. 2006; Anthony 2007). Therefore, understanding local residents' perceptions about conservation is the key to improve the protected areas-people relationship if protected areas are to achieve their goals (Weladji et al. 2003).

Understanding people's beliefs and attitudes toward protected areas is a key factor in developing successful management plans to conserve those areas over the long-term (Allendorf 2007). It is also essential to understand how heterogeneity within a community can result in a diverse range of attitudes and perceptions towards a protected area, and how these attitudes and perceptions can impact on long-term management (Suckall et al. 2009). Mulder et al. (2009) think that the conservation community has a special responsibility to foster conservation awareness in the local people who live in the vicinity of conservation areas having inordinately high levels of biodiversity. In Bangladesh, people's participation in forestry sector was started with the initiation of social forestry program by the state Forest Department. Muhammed et al. (2008) stated that according to the national forest policy guidelines, social forestry planning in Bangladesh should follow a bottom-up approach, but in practice, the people at grass-root level are not included in the planning process. Therefore, the people's actual needs and aspirations are not properly reflected in the policy and plan formulated. In the context of such reality, this chapter discusses the extent of community participation in co-management activities of Rema-Kalenga Wildlife Sanctuary, and analyzes the attitude of the local communities regarding various perceptions of forest conservation and community development in the vicinity of the Sanctuary. The 'attitude' was defined, based on the attitude theory of Ajzen and Fishbein (1980), as a human psychological tendency expressed by evaluating a particular object with favor or disfavor, or, like or dislike of the matters relating to protected area and its management (Allendorf et al. 2006).

7.2 State of Community Participation

7.2.1 Community Participation in Incentives Distribution

Nearly all the respondents (90 %) reported that they were well-informed of the goal of co-management project in Rema-Kalenga Wildlife Sanctuary. Almost no or very less discrepancy was seen in their knowledge on the project's goal

according to various categories except gender. The relative frequency of female respondents was less (70 %) than that of the other categories (Table 7.3) in possessing the knowledge on the goal of the project.

It was found that about 82 % of the respondents received trainings on various AIG activities from the Forest Department, i.e., the project implementing authority. The category-wise frequency of the FUG members who received the trainings is given in Table 7.3. The others (18 %) did not receive any training yet. But it was revealed that there was no contribution of the stakeholders in choosing the type of training. In response to the question on the authority of deciding the type of training to be given to the FUG members, most of the respondents (77.2 %) answered about the Forest Department while the remaining (22.8 %) did not want to make any comment on it. About 55 % beneficiaries commented that the training they received did not exactly match with their needs and the rest 45 % reported about its matching with needs (Fig. 7.1).

7.2.2 Monthly Meeting and Community Participation

A monthly meeting of Co-management Committee (CMC) is to be arranged in the study area with the attendance of all the FUG members. Only a very few respondents (9.6 %) were found as the member of the CMC, who were dominated by the males. The monthly meeting was reported to be conducted by the Forest Department in the arrangement of which, almost all the respondents (81.8 %) were reported to assist the authority. Although the FD was reported to fully control over the meeting, most of the respondents (76.2 %) could express their opinion in the meeting. Among the rests, 18.2 % reported not to express their opinion while the others (5.6 %) did not comment on this issue. If considered category-wise, the respondents belonging to minor-medium stake category were found to express the opinion more (81.9 %) than the others followed by the *Bangalee* group (79.5 %) according to ethnicity (Table 7.4). Thirty-six percent FUG members thought that the FD incorporates their suggestions given in the meeting in making any new decision, 25 % did not think like this way, while the remaining 39 % did not know exactly whether the FD's integration of their suggestions or not. However, with all these limitations in precise participation, more than 90 % FUG members expressed their satisfaction with the activities of FD. Interestingly it was seen that the cent percent satisfaction prevailed in the respondents of minor stake category.

7.2.3 Community Involvement in Forest Protection Activities

More than half of the respondents (53.3 %) were found to be directly involved in forest protection activities of various dimensions. The most involvement was seen in the FUG members living inside the forest (94.4 %), the least in those living

Table 7.3 Respondents' knowledge on project's goal and AIG trainings received from the authority

Parameters	Relative frequency of the respondents (%)											
	Overall	Village position			Village stake				Ethnicity		Gender	
		Inside	Adjacent	Outside	Major	Medium	Minor-medium	Minor	Bangalee	Tribe	Male	Female
Do you know the goals of NSP?												
Yes	90.1	94.4	87.7	92.6	88.2	90.9	90.3	100	91.0	86.2	96.1	70.0
No	9.9	5.6	12.3	7.4	11.8	9.1	9.7	–	9.0	13.8	3.9	30.0
Training from NSP?												
Yes	81.8	88.9	83.3	78.7	82.7	81.8	77.8	93.3	79.1	93.1	81.5	82.9
No	18.2	11.1	16.7	21.3	17.3	18.2	22.2	6.7	20.9	6.9	18.5	17.1
Who decides the type of training to be given to FUG members?												
FD	77.2 (FD = Forest Department)											
N. C.	22.8 (N. C. = No comments)											

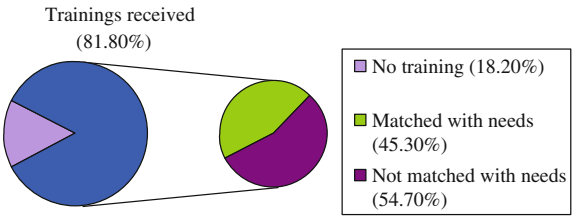

Fig. 7.1 Respondents' view on AIG trainings whether they are need-based or not

outside (4.1 %) and totally no involvement in the respondents under the categories of medium-minor and minor stakes (Table 7.5). In terms of ethnicity, more involvement was reported in the tribal communities (93.1 %) than their *Bangalee* neighbors (43.9 %).

A total of seven ways were documented in the study area the respondents involve themselves for the protection of forest resources of the sanctuary (Fig. 7.2). Creation of awareness by group discussion in local tea stalls in the evening leisure ranked the highest accepted way with the involvement of nearly 33 % of the respondents followed by caring the wildlife (19.9 %), forest patrolling (18.6 %) (Fig. 7.3), awareness creation by yard meeting (13.7 %) and so on. The category-wise involvement of the FUG members in various forest protection activities is given in Table 7.6.

7.2.4 Community Participation in Conflict Resolution

The communities themselves were reported not fully able to resolve the conflicts raised among the FUG members in the surrounding communities of Rema-Kalenga Wildlife Sanctuary (Table 7.7). More than half of the respondents (55.6 %) reported their inability to resolve it themselves. A considerable portion (80.8 %) of the community, irrespective of their ability to resolve it themselves or not, seeks consultation from the FD in settling the conflicts.

7.3 Community Attitudes

There were 15 statements symbolizing the perceptions of forest and biodiversity conservation, community development and community participation in co-management activities. These were to measure the respondents' attitude on those perceptions. The overall attitudinal measures are shown in Table 7.8. The levels of people's attitude according to various categories are given in Tables 7.9, 7.10, 7.11, and 7.12. Additionally, results of paired T-test for the respondents' attitude levels to the incentives are presented in Tables 7.13 and 7.14.

Table 7.4 Dimensions of community participation in monthly meeting of the CMC

Parameter	Relative frequency of the respondents (%)											
	Overall	Village position			Village stake				Ethnicity		Gender	
		Inside	Adjacent	Outside	Major	Medium	Minor-medium	Minor	Bangalee	Tribe	Male	Female
Are you a member of CMC?												
Yes	9.6	16.7	11.1	6.6	11.0	9.1	8.3	6.7	9.8	8.6	10.8	5.7
No	90.4	83.3	88.9	93.4	89.0	90.9	91.7	93.3	90.2	91.4	89.2	94.3
Do you think participation is important?												
Yes												
	100											
Monthly meeting is conducted by whom?												
FD												
	100											
Do the FUGs assist in arranging the meeting?												
Yes												
	81.8											
No												
	18.2											
Mostly who controls over the meeting?												
FD												
	100											
Can you express your opinion in the meeting?												
Yes	76.2	61.1	75.9	78.7	75.6	75.0	81.9	60.0	79.5	62.1	75.4	78.5
No	18.2	33.3	18.5	15.6	19.7	18.2	13.9	26.7	15.6	29.3	18.1	18.6
No comment	5.6	5.6	5.6	5.7	4.7	6.8	4.2	13.3	4.9	8.6	6.5	2.9
Does FD incorporate your suggestions in making new decisions?												
Yes	36.1	22.2	38.9	34.4	38.6	34.1	40.3	6.7	38.9	24.1	37.1	32.9
No	24.8	22.2	25.3	24.6	26.0	23.9	25.0	20.0	23.4	31.1	23.7	28.6
Don't know	39.1	55.6	35.8	41.0	35.4	42.0	34.7	73.3	37.7	44.8	39.2	38.5
Are you satisfied with FD activities?												
Yes	91.7	94.4	92.0	91.0	92.1	90.9	90.3	100	91.0	94.8	95.7	78.6
No	8.3	5.6	8.0	9.0	7.9	9.1	9.7	–	9.0	5.2	4.3	21.4

Table 7.5 Category-wise direct involvement of the community in forest protection activities

Category		Frequency (%)	
		Yes	No
Overall		53.3	46.7
Village position	Inside	94.4	5.6
	Adjacent	85.8	14.2
	Outside	4.1	95.9
Village stake level	Major	85.8	14.2
	Medium	59.1	40.9
	Minor-medium	–	100
	Minor	–	100
Ethnicity	Bangalee	43.9	56.1
	Tribe	93.1	6.9
Gender	Male	54.7	45.3
	Female	48.6	51.4

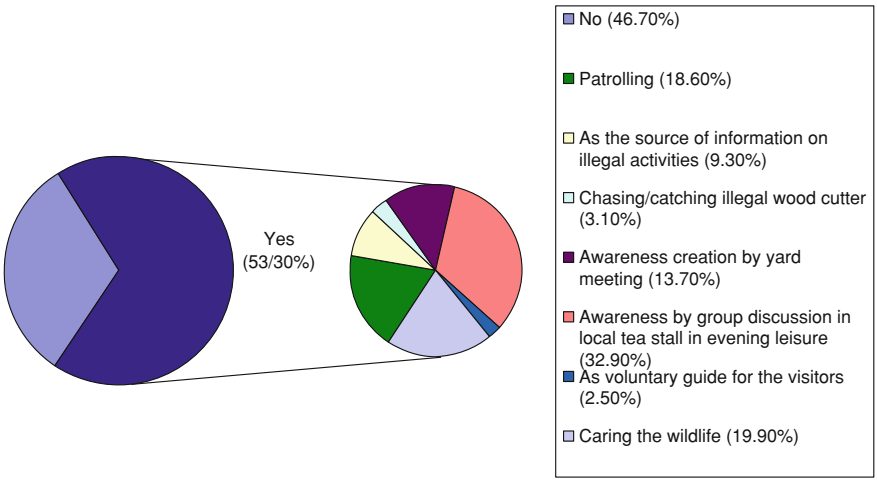

Fig. 7.2 Various ways of community's direct involvement in forest protection activities in Rema-Kalenga Wildlife Sanctuary

7.4 Discussion and Conclusion

Participation in forestry programs is, in essence, the empowerment of the people to effectively involve themselves in developing programs that serve the interest of all as well as to effectively contribute to the conservation activities (Blay et al. 2008). Regarding the participation of local community in co-management activities, an intermingling result has been drawn from this study. Although community participation was seen to have been occurring, the majority of the respondents perceived

Fig. 7.3 A forest patrolling team formed with members of the local community

their role to be passive instead of active involvement in the various stages. It is satisfactory that almost all the respondents knew the intended goal of the co-management program that might help them spot the problems prevailing in the sanctuary and act accordingly to achieve the goal. Lilltle (1994) also recognized that the extent to which the local people shares in problem definition and participates in its identification is a prime factor affecting program success.

Habitually local communities have a greater understanding of the unique conditions in their area that affect the natural resource and so can adapt their management techniques accordingly and more effectively than a centrally controlled management plan (Agrawal 2001). In the study area, decision on distribution of AIG trainings as the incentives was fully controlled by the project implementation authority. Since most of the staffs of the implementing agency are from outside, they don't have the clear understanding of the exact needs of the local community. As a result, many of the respondents had to receive trainings on need-not-based livelihood options that might make them apathetic in responding to forest conservation activities. Majority of the respondents blamed that although they knew their needs well, it was the strangers who analyzed the problems of the community and fixed the means of livelihoods. This reflects the communities' passive participation in decision-making about how the incentives were to be allocated among the members. In such perspectives, it has been thought that the objectives of achieving economic benefits for inhabitants living in and near the protected areas will only be possible if the management plans give considerable weight to the development of right livelihood options. This perception corresponds with Patwary (2008) who described the similar insight in the case of Chunati Wildlife Sanctuary, Bangladesh.

The local people were found aware about the matter of their participation in project activities. It is reflected from their response when they were asked a specific question "Do you think participation is important?" Undoubtedly, all of

Table 7.6 Category-wise direct involvement of FUG members in various forest protection activities

Ways of involvement	Relative frequency of the respondents (%)									
	Overall	Village position			Village stake		Ethnicity		Gender	
		Inside	Adjacent	Outside	Major	Medium	Bangalee	Tribe	Male	Female
Patrolling	18.6	–	21.6		18.3	19.2	23.4	9.3	23.6	
As source of information on illegal activities	9.3	5.9	10.1		11.9	3.8	12.1	3.7	11.0	2.9
Chasing/catching illegal cutters	3.1	–	3.6		3.7	1.9	4.7		3.9	
Awareness creation by yard meeting	13.7	5.9	15.1		15.6	9.6	14.0	13.0		64.7
Awareness by group discussion in local tea stall in evening leisure	32.9	47.1	30.9	40.0	29.4	40.4	30.8	37.0	41.7	
As voluntary guide for the visitors	2.5	5.9	2.2		3.7		1.9	3.7	3.1	
Sheltering the wildlife	19.9	35.3	16.5	60.0	17.4	25.0	13.1	33.3	16.5	32.4

Table 7.7 Way of resolving conflicts among the FUG members

Category		Frequency (%)			
		By communities themselves		With additional consultation of FD	
		Yes	No	Yes	No
Overall		44.4	55.6	80.8	19.2
Village position	Inside	33.3	66.7	72.2	27.8
	Adjacent	43.8	56.2	84.0	16.0
	Outside	46.7	53.3	77.9	22.1
Village stake	Major	45.7	54.3	82.7	17.3
	Medium	38.6	61.4	78.4	21.6
	Minor-medium	54.2	45.8	76.4	23.6
	Minor	20.0	80.0	100	–
Ethnicity	Bangalee	45.9	54.1	79.1	20.9
	Tribe	37.9	62.1	87.9	12.1
Gender	Male	45.7	54.3	81.9	18.1
	Female	40.0	60.0	77.1	22.9

them viewed their 'participation' important for two most prominent reasons—for their own well-being and for the sake of forest conservation. A good sign of community participation was evident from the majority of the respondents' freedom of expressing their opinions in the monthly meeting of CMC. But the question is to what extent their opinions and/or suggestions were incorporated during making and fixing any decision. The answer is undoubtedly dissatisfactory, which was reflected from the respondents' further opinions. While a little portion of them (36 %) thought that the Forest Department valued their suggestions and incorporated them finally during decision-making, 25 % opined against them. Moreover, the rest (39 %) did not have any idea about the future of their suggestions once made in the meetings. The authority also did not feel any responsibility to make any follow-up of the matters of the preceding meetings. This suggests a careful and intentional trick of the project authority to deceive the local people actually. Continuous interactions between both parties are required to establish effective results: this is not a fast process and establishing this type of participation is difficult when large distances exist between those involved. Although the goal is to establish a more equal and fair relationship, certain hierarchies of roles among those from outside and those from inside the community are always maintained, at least in the beginning (Ericson 2006).

Growing conflicts between biodiversity conservation interests and local communities over the utilization of natural resources are well-known since the very beginning (Warner 2000). Different types of conflicts can be categorized in terms of whether they occur at the micro–micro or micro–macro levels, i.e., among community groups or between community groups and outside government, private or civil society organizations (Grimble and Wellard 1997). Conflicts, as elsewhere around the world, are also common in the study area. But conflicts here among local people and the project authority have been simple and at a level that has not

Table 7.8 Mean value of respondents' agreeing or disagreeing with conservation statements

Sl. No.	Statements	Mean value	Remarks
1	Forests around my village have decreased in the years before the project started	4.61 (SE, 0.04)	Strongly agree
2	It is responsibility of local people to protect natural resources	3.78 (SE, 0.07)	Agree
3	If there is unlimited access to forests for fuel wood and fodder, forests will be disappeared soon	4.78 (SE, 0.03)	Strongly agree
4	There are more wild animals now than 4 years ago	3.02 (SE, 0.07)	Neutral
5	What people and their livestock need are more important than saving plants and wild animals	2.97 (SE, 0.06)	Neutral
6	My living condition improved since the co-management started	4.08 (SE, 0.06)	Agree
7	After the establishment of buffer zone forests/ reserve I don't have problem of access to resources	2.59 (SE, 0.06)	Disagree
8	It is important to set aside a place for the animals and plants to live in	3.56 (SE, 0.05)	Agree
9	It is important to protect the animals and plants so that our children may know and use them sustainably	4.20 (SE, 0.05)	Agree
10	There is an equitable distribution of common pool resources and benefits to the communities by CMC/FD	1.38 (SE, 0.04)	Strongly disagree
11	I am willing to contribute for conservation process	4.58 (SE, 0.03)	Strongly agree
12	AIG activities are able to reduce pressure on forests	4.48 (SE, 0.04)	Agree
13	We are now more aware of conserving forests due to campaigning by Nishorgo	4.10 (SE, 0.05)	Agree
14	Training on improved stove is necessary to know how forest can saved using less amount of wood	2.75 (SE, 0.06)	Disagree
15	The behavior and attitude of the FD official towards local marginal people have been changed positively since the co-management started	3.01 (SE, 0.06)	Neutral

become critical to the community. However, the existence of conflict has been reported in some activities and not in others, and in some groups but not in all the groups. Levels of conflict among members of the community and the management authority were typical of the activities undertaken involving the provision of incentives and the exploitation of forest resources (Patwary 2008). Mostly interpersonal conflicts, conflicts within groups, and combination of groups and management authority were noticed in the study area. Conflicts were also reported to arise from the deprivation of benefits and incentives to specific groups of the community. Most of the time, women are the vulnerable portion of these groups. The blame of devaluating the women FUG members in selecting for the AIG training was reported in the Focus Group Discussion with the female members of the community. Such attitude of the project agency must deter an important fraction of the local community from taking part in the development activities in forestry sector. Lachapelle et al. (2004) explored three broad reasons that hinder

Table 7.9 Mean value of respondents' agreeing or disagreeing with conservation statements according to village position

Sl. No.	Statements	Village position		
		Inside	Adjacent	Outside
1	Forests around my village have decreased in recent years	4.78 (SE, 0.10)[a]	4.56 (SE, 0.05)[a]	4.66 (SE, 0.06)[a]
2	It is responsibility of local people to protect natural resources	3.89 (SE, 0.30)[a]	3.80 (SE, 0.09)[a]	3.75 (SE, 0.10)[a]
3	If there is unlimited access to forests for fuel wood and fodder, forests will be disappeared soon	4.94 (SE, 0.06)[a]	4.75 (SE, 0.04)[a]	4.78 (SE, 0.06)[a]
4	There are more wild animals now than 4 years ago	2.22 (SE, 0.24)[a]	3.06 (SE, 0.09)[b]	3.08 (SE, 0.11)[c]
5	What people and their livestock need are more important than saving plants and wild animals	2.72 (SE, 0.25)[a]	2.94 (SE, 0.09)[a]	3.03 (SE, 0.10)[a]
6	My living condition improved since the co-management started	4.06 (SE, 0.19)[a]	4.17 (SE, 0.07)[a]	3.97 (SE, 0.10)[a]
7	After the establishment of buffer zone forests/reserve I don't have problem of access to resources	3.00 (SE, 0.23)[a]	2.62 (SE, 0.08)[a]	2.48 (SE, 0.09)[a]
8	It is important to set aside a place for the animals and plants to live in	3.28 (SE, 0.16)[a]	3.52 (SE, 0.07)[a]	3.65 (SE, 0.08)[a]
9	It is important to protect the animals and plants so that our children may know and use them sustainably	4.17 (SE, 0.19)[a]	4.22 (SE, 0.07)[a]	4.19 (SE, 0.08)[a]
10	There is an equitable distribution of common pool resources and benefits to the communities by CMC/FD	1.28 (SE, 0.16)[a]	1.41 (SE, 0.05)[a]	1.36 (SE, 0.06)[a]
11	I am willing to contribute for conservation process	4.44 (SE, 0.12)[a]	4.54 (SE, 0.05)[a]	4.65 (SE, 0.05)[a]
12	AIG activities are able to reduce pressure on forests	4.50 (SE, 0.12)[a]	4.48 (SE, 0.05)[a]	4.48 (SE, 0.07)[a]
13	We are now more aware of conserving forests due to campaigning by Nishorgo	4.22 (SE, 0.17)[a]	4.16 (SE, 0.07)[a]	3.99 (SE, 0.08)[a]
14	Training on improved stove is necessary to know how forest can saved using less amount of wood	3.06 (SE, 0.17)[a]	2.76 (SE, 0.09)[a]	2.68 (SE, 0.10)[a]
15	The behavior and attitude of the FD official towards local marginal people have been changed positively since the co-management started	2.83 (SE, 0.29)[a]	2.96 (SE, 0.08)[a]	3.11 (SE, 0.10)[a]

Values in parentheses indicate standard error

[a–b] indicate that values are significantly different at the $p < 0.05$ significant level

Table 7.10 Mean value of respondents' agreeing or disagreeing with conservation statements according to village stake

Sl. No.	Statements	Village stake			
		Major	Medium	Minor-medium	Minor
1	Forests around my village have decreased in recent years	4.55 (SE, 0.06)[a]	4.66 (SE, 0.07)[a]	4.68 (SE, 0.07)[a]	4.47 (SE, 0.22)[a]
2	It is responsibility of local people to protect natural resources	3.81 (SE, 0.10)[a]	3.75 (SE, 0.12)[a]	3.78 (SE, 0.14)[a]	3.80 (SE, 0.28)[a]
3	If there is unlimited access to forests for fuel wood and fodder, forests will be disappeared soon	4.76 (SE, 0.05)[a]	4.77 (SE, 0.07)[a]	4.78 (SE, 0.07)[a]	4.87 (SE, 0.09)[a]
4	There are more wild animals now than 4 years ago	3.14 (SE, 0.10)[a]	2.82 (SE, 0.13)[b]	3.15 (SE, 0.14)[c]	2.47 (SE, 0.26)[d]
5	What people and their livestock need are more important than saving plants and wild animals	2.94 (SE, 0.10)[a]	3.01 (SE, 0.12)[a]	3.03 (SE, 0.13)[a]	2.67 (SE, 0.23)[a]
6	My living condition improved since the co-management started	4.16 (SE, 0.09)[a]	4.14 (SE, 0.11)[a]	3.92 (SE, 0.14)[a]	3.87 (SE, 0.22)[a]
7	After the establishment of buffer zone forests/reserve I don't have problem of access to resources	2.60 (SE, 0.09)[a]	2.60 (SE, 0.11)[b]	2.39 (SE, 0.11)[c]	3.40 (SE, 0.21)[d]
8	It is important to set aside a place for the animals and plants to live in	3.50 (SE, 0.08)[a]	3.65 (SE, 0.09)[a]	3.60 (SE, 0.11)[a]	3.27 (SE, 0.15)[a]
9	It is important to protect the animals and plants so that our children may know and use them sustainably	4.21 (SE, 0.08)[a]	4.22 (SE, 0.09)[a]	4.11 (SE, 0.11)[a]	4.47 (SE, 0.17)[a]
10	There is an equitable distribution of common pool resources & benefits to the communities by CMC/FD	1.40 (SE, 0.06)[a]	1.42 (SE, 0.07)[a]	1.33 (SE, 0.07)[a]	1.27 (SE, 0.15)[a]
11	I am willing to contribute for conservation process	4.56 (SE, 0.05)[a]	4.58 (SE, 0.07)[a]	4.64 (SE, 0.07)[a]	4.40 (SE, 0.13)[a]
12	AIG activities are able to reduce pressure on forests	4.45 (SE, 0.06)[a]	4.51 (SE, 0.07)[a]	4.49 (SE, 0.08)[a]	4.47 (SE, 0.13)[a]
13	We are now more aware of conserving forests due to campaigning by Nishorgo	4.17 (SE, 0.08)[a]	4.03 (SE, 0.09)[a]	4.01 (SE, 0.11)[a]	4.27 (SE, 0.21)[a]
14	Training on improved stove is necessary to know how forest can saved using less amount of wood	2.81 (SE, 0.10)[a]	2.66 (SE, 0.12)[a]	2.78 (SE, 0.13)[a]	2.53 (SE, 0.19)[a]
15	The behavior/attitude of the FD official towards local people have been changed positively since the co-management started	2.90 (SE, 0.09)[a]	3.09 (SE, 0.12)[a]	3.14 (SE, 0.12)[a]	2.80 (SE, 0.31)[a]

Values in parentheses indicate standard error

[a–d] indicate that values are significantly different at the $p < 0.05$ significant level

Table 7.11 Mean value of respondents' agreeing or disagreeing with conservation statements according to the respondents' ethnicity

Sl. No.	Statements	Ethnicity	
		Bangalee	Tribe
1	Forests around my village have decreased in recent years	4.60 (SE, 0.04)[a]	4.64 (SE, 0.08)[a]
2	It is responsibility of local people to protect natural resources	3.77 (SE, 0.07)[a]	3.83 (SE, 0.56)[a]
3	If there is unlimited access to forests for fuel wood and fodder, forests will be disappeared soon	4.76 (SE, 0.04)[a]	4.83 (SE, 0.06)[a]
4	There are more wild animals now than 4 years ago	3.08 (SE, 0.08)[a]	2.76 (SE, 0.15)[a]
5	What people and their livestock need are more important than saving plants and wild animals	3.00 (SE, 0.07)[a]	2.81 (SE, 0.15)[a]
6	My living condition improved since the co-management started	4.07 (SE, 0.07)[a]	4.12 (SE, 0.12)[a]
7	After the establishment of buffer zone forests/ reserve I don't have problem of access to resources	2.49 (SE, 0.06)[a]	3.02 (SE, 0.14)[b]
8	It is important to set aside a place for the animals and plants to live in	3.59 (SE, 0.06)[a]	3.40 (SE, 0.09)[a]
9	It is important to protect the animals and plants so that our children may know and use them sustainably	4.18 (SE, 0.06)[a]	4.29 (SE, 0.10)[a]
10	There is an equitable distribution of common pool resources and benefits to the communities by CMC/FD	1.39 (SE, 0.04)[a]	1.34 (SE, 0.09)[a]
11	I am willing to contribute for conservation process	4.60 (SE, 0.04)[a]	4.48 (SE, 0.07)[a]
12	AIG activities are able to reduce pressure on forests	4.45 (SE, 0.05)[a]	4.57 (SE, 0.07)[a]
13	We are now more aware of conserving forests due to campaigning by Nishorgo	4.09 (SE, 0.06)[a]	4.12 (SE, 0.10)[a]
14	Training on improved stove is necessary to know how forest can saved using less amount of wood	2.74 (SE, 0.07)[a]	2.78 (SE, 0.13)[a]
15	The behavior and attitude of the FD official towards local marginal people have been changed positively since the co-management started	3.06 (SE, 0.07)[a]	2.81 (SE, 0.14)[a]

Values in parentheses indicate standard error
[a–b] indicate that values are significantly different at the $p < 0.05$ significant level

population participation in resource management. These are: vulnerability (lack of private resources), inferiority (arising due to discrimination based on caste, gender and education) and the potential for corruption, especially due to lack of funding transparency. Additionally, Baral and Heinen (2007a) found social and economic considerations as the influencing factors in the level of participation in forest management programs. They revealed that gender, education, household affluence and conservation attitudes were the significant predictors of whether people participate, and these are positively correlated with participation in two protected areas in western Terai of Nepal (Baral and Heinen 2007b). Greater involvement of women in communities leads to wider participation in general (Lise 2000). This is

Table 7.12 Mean value of respondents' agreeing or disagreeing with conservation statements according to the respondents' gender

Sl. No.	Statements	Gender	
		Male	Female
1	Forests around my village have decreased in recent years	4.56 (SE, 0.05)[a]	4.76 (SE, 0.06)[b]
2	It is responsibility of local people to protect natural resources	3.78 (SE, 0.07)[a]	3.80 (SE, 0.15)[a]
3	If there is unlimited access to forests for fuel wood and fodder, forests will be disappeared soon	4.76 (SE, 0.07)[a]	4.83 (SE, 0.06)[a]
4	There are more wild animals now than 4 years ago	2.91 (SE, 0.08)[a]	3.37 (SE, 0.13)[b]
5	What people and their livestock need are more important than saving plants and wild animals	2.90 (SE, 0.07)[a]	3.20 (SE, 0.14)[b]
6	My living condition improved since the co-management started	4.05 (SE, 0.07)[a]	4.17 (SE, 0.11)[a]
7	After the establishment of buffer zone forests/ reserve I don't have problem of access to resources	2.69 (SE, 0.07)[a]	2.24 (SE, 0.10)[b]
8	It is important to set aside a place for the animals and plants to live in	3.40 (SE, 0.05)[a]	3.82 (SE, 0.10)[b]
9	It is important to protect the animals and plants so that our children may know and use them sustainably	4.16 (SE, 0.06)[a]	4.33 (SE, 0.10)[a]
10	There is an equitable distribution of common pool resources and benefits to the communities by CMC/FD	1.38 (SE, 0.04)[a]	1.41 (SE, 0.08)[a]
11	I am willing to contribute for conservation process	4.55 (SE, 0.04)[a]	4.67 (SE, 0.07)[a]
12	AIG activities are able to reduce pressure on forests	4.52 (SE, 0.05)[a]	4.34 (SE, 0.06)[a]
13	We are now more aware of conserving forests due to campaigning by Nishorgo	4.07 (SE, 0.06)[a]	4.19 (SE, 0.10)[a]
14	Training on improved stove is necessary to know how forest can saved using less amount of wood	2.88 (SE, 0.07)[a]	2.29 (SE, 0.14)[b]
15	The behavior and attitude of the FD official towards local marginal people have been changed positively since the co-management started	3.06 (SE, 0.07)[a]	2.86 (SE, 0.13)[a]

Values in parentheses indicate standard error
[a–b] indicate that values are significantly different at the $p < 0.05$ significant level

because women constitute about the half of the total population but are more involved in resource extraction, so their exclusion can seriously undermine conservation initiatives (Baral and Heinen 2007a). Involvement of women in decision-making, benefit sharing and role in forest management has shown improvement following the introduction of participatory approach in the management of Bonga forests in Ethiopia (Gobeze et al. 2009).

The positive attitude among the majority of the respondents of the community living in and around Rema-Kalenga Wildlife Sanctuary regarding various dimensions of conservation perceptions is a very encouraging finding. Among the 15 statements (combination of conservation, socio-economic development of the

Table 7.13 Paired T-test for respondents' attitude level on various conservation perceptions to the incentives (increase in respondents' annual income)

Parameter	df	Paired differences					t	Sig. (2-tailed)
		Mean	Std. dev.	Std. error	95 % confidence interval of the difference			
					Lower	Upper		
Statement-1 to incentives (increased income)	301	17,693.74	14,904.42	857.65	19,381.49	16,005.98	20.63	0.000
Statement-2 to incentives (increased income)	301	17,694.56	14,904.39	857.65	19,382.31	16,006.81	20.63	0.000
Statement-3 to incentives (increased income)	301	17,693.57	14,904.43	857.65	19,381.33	16,005.81	20.63	0.000
Statement-4 to incentives (increased income)	301	17,695.33	14,904.49	857.66	19,383.56	16,007.56	20.63	0.000
Statement-5 to incentives (increased income)	301	17,695.38	14,904.38	857.65	19,383.13	16,007.63	20.63	0.000
Statement-6 to incentives (increased income)	301	17,695.30	14,904.45	857.65	19,383.06	16,007.54	20.63	0.000
Statement-7 to incentives (increased income)	301	17,695.75	14,904.33	857.65	19,383.50	16,008.01	20.63	0.000
Statement-8 to incentives (increased income)	301	17,694.79	14,904.55	857.66	19,382.56	16,007.02	20.63	0.000
Statement-9 to incentives (increased income)	301	17,694.14	14,904.41	857.65	19,381.90	16,006.39	20.63	0.000
Statement-10 to incentives (increased income)	301	17,696.96	14,904.41	857.65	19,384.74	16,009.21	20.63	0.000
Statement-11 to incentives (increased income)	301	17,693.77	14,904.47	857.66	19,381.53	16,006.01	20.63	0.000
Statement-12 to incentives (increased income)	301	17,693.87	14,904.41	857.66	19,381.53	16,006.11	20.63	0.000
Statement-13 to incentives (increased income)	301	17,694.25	14,904.37	857.65	19,382.00	16,006.50	20.63	0.000
Statement-14 to incentives (increased income)	301	17,695.60	14,904.40	857.65	19,383.35	16,007.85	20.63	0.000
Statement-15 to incentives (increased income)	301	17,695.60	14,904.40	857.65	19,383.35	16,007.85	20.63	0.000

Table 7.14 Paired T-test for respondents' attitude level on various conservation perceptions to the incentives (agri-land leased to respondents by the FD)

Parameter	df	Paired differences					t	Sig. (2-tailed)
		Mean	Std. dev.	Std. error	95 % confidence interval of the difference			
					Lower	Upper		
Statement-1 to incentives (agri-land)	301	172.63	105.13	6.05	184.53	160.72	28.54	0.000
Statement-2 to incentives (agri-land)	301	173.45	105.04	6.04	185.35	161.56	28.70	0.000
Statement-3 to incentives (agri-land)	301	172.46	105.14	6.05	184.37	160.56	28.51	0.000
Statement-4 to incentives (agri-land)	301	174.22	105.17	6.05	186.13	162.31	28.79	0.000
Statement-5 to incentives (agri-land)	301	174.27	105.14	6.05	186.18	162.37	28.80	0.000
Statement-6 to incentives (agri-land)	301	174.19	105.16	6.05	186.10	162.28	28.79	0.000
Statement-7 to incentives (agri-land)	301	174.65	105.05	6.04	186.54	162.75	28.89	0.000
Statement-8 to incentives (agri-land)	301	173.68	105.19	6.05	185.59	161.77	28.69	0.000
Statement-9 to incentives (agri-land)	301	173.04	105.12	6.05	184.94	161.13	28.61	0.000
Statement-10 to incentives (agri-land)	301	175.85	105.17	6.05	187.76	163.94	29.06	0.000
Statement-11 to incentives (agri-land)	301	172.66	105.15	6.05	184.57	160.75	28.54	0.000
Statement-12 to incentives (agri-land)	301	172.76	105.09	6.05	184.66	160.86	28.57	0.000
Statement-13 to incentives (agri-land)	301	173.14	105.08	6.05	185.04	161.24	28.64	0.000
Statement-14 to incentives (agri-land)	301	174.49	105.05	6.04	186.39	162.60	28.87	0.000
Statement-15 to incentives (agri-land)	301	174.23	105.22	6.05	186.14	162.31	28.77	0.000

community, and their participation grade), the respondents were found to 'strongly agree' with three, 'agree' with six, 'disagree' with two, 'strongly disagree' with one while remain 'neutral' with three statements. The evidence of forest degradation in recent past was manifested from their attitude on the perception of forest and biodiversity status, which was expressed by the statements "Forests around my village have decreased in recent years", "There are more wild animals now than 4 years ago". A varying attitude was noticed regarding the perception of forest and biodiversity conservation which was articulated by the statements "If there is unlimited access to forests for fuel wood and fodder, forests will be disappeared soon", "What people and their livestock need are more important than saving plants and wild animals", "It is important to set aside a place for the animals and plants to live in", "It is important to protect the animals and plants so that our children may know and use them sustainably", "We are now more aware of conserving forests due to campaigning by Nishorgo", and "I am willing to contribute for conservation process". They agreed (Mean = 3.78, SE = 0.07) with the statement regarding the custodianship of forest resources that stated that the protection of natural resources should be the responsibility of local people. Perceptions of socio-economic upliftment and the role of AIG trainings on it were found positive from their agreeing with the related statements like "My living condition improved since the co-management started" and "AIG activities are able to reduce pressure on forests". A matter of resource use conflicts was reflected from the communities' disagreeing (Mean = 2.59, SE, 0.06) with the statement "After the establishment of buffer zone forests/reserve I don't have problem of access to resources". A negative attitude on the perception of the activities of Forest Department as the project implementation authority was mirrored by the comparatively lower mean values of the statements "There is an equitable distribution of common pool resources and benefits to the communities by CMC/FD" (Mean = 1.38, SE = 0.04), "Training on improved stove is necessary to know how forest can saved using less amount of wood" (Mean = 2.75, SE = 0.06) and "The behavior and attitude of the FD official towards local marginal people have been changed positively since the co-management started" (Mean = 3.01, SE = 0.06). The positive attitude of the local people regarding various dimensions of two protected areas of Nepal were also revealed by Mehta and Heinen (2001), where about 85 % of respondents showed favorable attitudes toward the conservation areas. In Pakistan, local communities living in the periphery of Chitral Gol National Park know about the importance of the protected area, 68 % of them are friendly with park management and the willingness of communities to participate in the management and protection of wildlife is high (97.1 %) (Khan and Bhagwat, 2010). Dimitrakopoulos et al. (2010) reported the presence of relatively high level of knowledge in local residents regarding the existence of three wetland protected areas in Greece.

Local people's perceptions are determined by their values and frames of reference (ecological, economic and ethnological/cultural) which lead to differences in needs, perceptions and attitudes along the lines of their personal attributes. It has been recognized that many demographical factors, such as age, education, residence location, affluence and ethnic origin can significantly shape the attitudes of

local (Mehta and Heinen 2001; Bandara and Tisdell 2003). The people in the study area mostly had favorable attitudes on various perceptions. However, there are many similarities as well as differences according to the categories based on the village position, village stake level, ethnicity and gender. It was found that the perception of the respondents about wildlife population trends varied significantly ($p < 0.05$ significant level) among the communities according to the village position. This perception was measured by the respondents' attitude on the statement "There are more wild animals now than 4 years ago". There was no significant difference on the other perceptions among the respondents according to the village position. The attitude on the similar perception along with the perception of resource use conflict was also found significantly different among the respondents according to the village stake level. There was no significant difference on the other perceptions among the respondents according to the village stake. Ethnicity-wise significant difference on the respondents' attitude about the perception of resource use conflict was found regarding the opinions on the statement "After the establishment of buffer zone forests/reserve I don't have problem of access to resources", while no significant difference was seen on the other perceptions. The most significant difference was found in the mean values of the respondents' attitude about various perceptions according to their gender. The perceptions with significant difference were related to forest and biodiversity status, wildlife population trends, few conservation attitudes, resource use conflict and the inefficacy of one of the AIG strategies, i.e., training on improved cooking stoves. Ethnicity and gender along with some other socio-economic and demographic factors were found significant predictors of conservation attitudes among other communities worldwide (e.g., Fiallo and Jacobson 1995; Mehta and Kellert 1998; Gillingham and Lee 1999; Sah and Heinen 2001).

Perceptions of rural farmers with regards to protected areas, and particularly to forests may differ among farmers according to their socio-economic and demographic situations. For example, some group members might be concerned about the degree of deforestation of the reserve and prefer government and NGO intervention in putting in place environmental policies for management of the reserve. Others may be more concerned about the economic benefits of the reserve (Dolisca et al. 2007). Many factors influence the perceptions of the protected areas held by local residents living in their periphery which include the history of park management, the degree of awareness of protected areas existence, the education level, the reference to future generation, and the gender and ethnicity (Vodouhe et al. 2010). The understanding of all these factors is important to improve the relationship between local residents and protected areas and will improve people awareness about biodiversity conservation within these areas (Vodouhe et al. 2010). A major divergence was seen in the perceptions of local people over various aspects of Joint Forest Management program in Tamil Nadu, India (Matta and Alavalapati 2006). In the study area, a significant contribution of the incentives was found on the level of the respondents' attitude on various conservation perceptions. Increase in annual income that was the consequence of the trainings on various AIG activities, and leasing of vacant agricultural lands in and around

the sanctuary were considered the incentives here. These were believed to have the influence on the level of the respondents' attitudes as the powerful factors in this regard. The similar trend was revealed by Baral and Heinen (2007a, b) in the communities of Bardia National Park and Sukla Phanta Wildlife Reserve, Nepal where they suggested that, as the main purpose of training is skill enhancement for income generation, yet NGOs can take the opportunity to raise conservation awareness during sessions. This tactic might be applied for our study area also. But the absence of equity in distribution of the AIG trainings appeared as a severe problem, as depicted from the respondents' strongly disagreeing (Mean = 1.38, SE = 0.04) with the statement "There is an equitable distribution of common pool resources and benefits to the communities by CMC/FD". This is a 'red flag' suggesting the authority's immediate attention if the goals of the project are to be achieved properly. In the Focus Group Discussion, the respondents complained that their agricultural crops seldom suffered from the damage by wildlife, particularly the monkeys. But it did not oscillate their positive conservation attitude because most of them thought that benefits accrued through the project activities at the societal level were effective in offsetting local costs unlike the communities studied by Akama et al. (1995), and Gillingham and Lee (1999).

Participation in decision-making and strategy-formulation triggers learning and helps to strengthen collaborative relationships and trust (Schusler et al. 2003). This became more or less true for the communities in the study area because they mentioned the learning about the protection regime and the functioning of the management authority. This was reflected by their agreeing (Mean = 4.10, SE = 0.05) with the statement "We are now more aware of conserving forests due to campaigning by the FD". Ziadat (2009) reported that environmental awareness in Jordan as a third world country has moved a long way toward understanding the significance and need for a cleaner environment and better social-environmental behaviors. However, personal actions, levels of political environmental literacy, and obligations of citizens to improve the environment appear to lag behind in comparison with people in developed countries. In the study area, although overall a neutral attitude towards the perception of the pro-people behavior of the authority, negative attitude was observed category-wise. The women and tribal groups were found more vulnerable in this regard. By disagreeing with the statement "The behavior and attitude of the FD official towards local marginal people have been changed positively since the co-management started", they expressed their negative attitude to this particular issue. Traditionally, in rural societies of Bangladesh, women have subordinate role and less power in decision-making, and men usually dominate; but realistically women are more involved in forestry activities in terms of resource extraction and maintenance. Therefore, special attention is to be given to eliminate the gender inequality by encouraging the women for more involvement in co-management activities.

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Chapter 8
Biodiversity Conservation and Ecosystem Functions of Traditional Agroforestry Systems: Case Study from Three Tribal Communities in and Around Lawachara National Park

Sharif Ahmed Mukul

Abstract Agroforestry—now-a-days considered as a future land-use strategy due to its' structural complexity and perceived environmental benefits. The present study was performed on four contrasting traditional agroforestry systems (i.e. betel vine based *Khasia* agroforestry, lemon and pineapple based *Tripura* agroforestry, and short-term shifting cultivation practised by the *Garo* tribes) in Bangladesh, to realize their conservation prospects (in terms of plants, birds and mammalian diversity) and ecosystem benefits. The study identified betel vine (*Piper betel*) based agroforestry system in the area as critical in conserving biodiversity and maintenance of few ecosystem services. In Bangladesh, where poverty and high population density is widespread with higher dependence on forests for livelihoods and high deforestation rate, indigenous agroforestry systems could potentially be used to bridge the gap between conservation and livelihoods. Incorporating such systems in REDD + mechanism could also be used for sustainable financing of conservation projects in protected areas in human dominated landscapes.

8.1 Introduction

Agricultural expansions has widely recognized as the major driver of forests and biodiversity loss in developing countries (Sala et al. 2000). It is also one of the main challenges today, particularly in the developing tropics in order to meet the

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M. S. H. Chowdhury (ed.), *Forest Conservation in Protected Areas of Bangladesh*,
World Forests 20, DOI: 10.1007/978-3-319-08147-2_8,

ever growing demand for agricultural products while conserving biodiversity, providing and regulating critical ecosystem services, and maintaining rural livelihoods (Harvey and Gonzalez 2007). As rates of deforestation continue to rise in many parts of the tropics, the international conservation community is faced with the challenge of finding approaches which can reduce deforestation and provide rural livelihoods in addition to conserving biodiversity (Bhagwat et al. 2008). Agroforestry is an integration of agricultural and forestry production system, and has believed to hold a great potentials for conserving biodiversity (Schroth et al. 2004). There has been lot of evidences where agroforestry has been found suitable for biodiversity conservation over agricultural practices. The tropical region is the home of world's most diverse and traditional agroforestry systems practiced by indigenous communities that have proven their conservation potentials while providing or maintaining other necessary services and benefits (Schroth et al. 2004). The coffee, cacao or the jungle rubber production systems are some example. However these systems are also in verge of extinction due to rapid intensification to increase crop yields or productivity. Understanding biodiversity pattern is essential in establishing science based conservation strategies (Trimble and van Aarde 2012). Conservationists from across the globe in the last years hence tries to explore the role of these age old agro-ecosystems in conserving biodiversity (Schroth et al. 2004).

Bangladesh, being situated in the tropical climate also exceptionally rich in biodiversity (Appanah and Ratnam 1992). In the country there are many agroforestry systems that have been managed by local or indigenous communities for decades. However, atypical to other tropical countries the country also now facing the challenge of intensified management over its traditional agroforestry management systems (Khan et al. 2006), which further accelerated by market forces, rapid development and need for more foods and other products necessary for sustaining livelihoods (Mukul et al. 2012,2014. Although numerous research works have so far been conducted on various aspects of agroforestry in the country (Khan et al. 2006; Alam et al. 2007) but their conservation role or complementarities as forest have rarely been evaluated. The present study was performed in a north-eastern protected area of the country characterized by four traditional agroforestry systems, viz., betel-vine (*Piper betel*) based *Khasia* agroforestry system, lemon (*Citrus limon*) and pineapple (*Ananas comosus*) based *Tripura* agroforestry systems and short-term shifting cultivation system followed by the *Garo* tribe (Figs. 8.1, 8.2, 8.3 and 8.4). The aim of the study was to explore the plant and wildlife diversity in these agroforestry systems and to assess the role play by these agroforestry systems to sustain ecosystem functions taking carbon storage as an example. The study is useful for understanding conservation values of such systems in protected areas, and to reevaluate their potentials for conservation and management of protected areas in human dominated landscapes.

Fig. 8.1 Betel leaf harvesting from the betel vine (*Piper betel*)-based *Khasia* agroforestry system in Lawachara NP

Fig. 8.2 Lemon (*Citrus limon*)-based *Tripura* agroforestry system in and around LNP

Fig. 8.3 Pineapple (*Ananas comosus*)-based *Tripura* agroforestry system in and around LNP

Fig. 8.4 Short-term shifting cultivation system by the *Garo* tribe in the forests of LNP

8.2 Findings of the Study

8.2.1 Site Characteristics

Table 8.1 shows the physical and historical attributes of the survey plots. Averaged elevation was highest (34.1 m) in case of betel-vine agroforestry plots where pineapple agroforestry plots were located in steeper slope (39.5°). Also canopy coverage in the studied agroforestry plots were highest (40.5 %) in case of betel-vine based agroforestry system followed by in forest (34.3 %). Amongst the survey plots, betel-vine based agroforestry plots were under such kind of land-uses for about 39 years, whereas the plots under shifting cultivation system was only 1 year old because the system is different than the conventional shifting cultivation system as followed in south-east Asia and only permitted by the forest department for only 1 season after clear felling a site and/or before establishment of new plantation.

Table 8.1 Physical and historical attributes of the sites

Variable	Land cover/agroforestry land use				
	Forest	Betel-vine agroforestry	Lemon agroforestry	Pineapple agroforestry	Shifting cultivation
Elevation (m)	29.1 (±10.39)	34.1 (±17.97)	26.8 (±11.93)	24.6 (±7.30)	27.9 (±9.50)
Slope (in degree)	17.0 (±14.76)	28.5 (±16.51)	17.0 (±8.56)	39.5 (±13.01)	28.0 (±15.31)
Canopy cover (%)	34.3 (±13.27)	40.5 (±12.35)	17.2 (±6.49)	4.2 (±2.53)	7.1 (±4.48)
Year under land cover/use	65.8 (±15.94)	39.0 (±15.6)	20 (±8.22)	17.5 (±6.84)	1.0 (0.0)

Values in the parenthesis indicate the (±SD) under corresponding group/sub-group

8.2.2 Plant Diversity

A total of 188 plant species were recorded from the study plots. Among the species 66 were tree followed by 49 herbs, 48 shrubs, 20 climbers and 5 species of orchids. Shannon-Weiner biodiversity index (*H*) was highest (3.29) in case of betel-vine based agroforestry system, followed by in lemon agroforestry system (2.85) and in forest (2.71). Betel-vine based agroforestry system also supported the highest number of tree (46), herbs (38) and climber species (14). Astonishingly, the number of trees and saplings in unit area also highest in case of betel-vine based agroforestry system (1,670 individuals/ha) as compared to forest (1,490). However the number of tree seedlings (per ha) was highest (19,375) in forest followed by in betel-vine based agroforestry system (19,000). Table 8.2 shows the plant diversity and other information in the studied agroforestry plots and in plots in the forest. The number of cultivated species was higher in shifting cultivation areas. Also both forest and agroforestry areas supported eight plant species those are endangered and 'Red listed' locally.

8.2.3 Wildlife Diversity

During the survey 27 mammalian species and 53 bird species were recorded from the studied land-uses/cover. Interestingly, betel-vine based agroforestry system holds the highest diversity of birds (31 species), followed by 23 species recorded from the forest. Also highest diversity of mammals was found in forest (15 species) followed by in betel-vine based agroforestry areas (11 species), lemon agroforestry (11 species), shifting cultivation (8 species) and pineapple agroforestry (7 species) system (Fig. 8.5). The survey however does not represent the actual diversity since the survey was carried out during the day and was constrained by time.

Table 8.2 Plant diversity in forest and in the agroforestry land uses

Variable	Land cover/agroforestry land use				
	Forest	Betel-vine agroforestry	Lemon agroforestry	Pineapple agroforestry	Shifting cultivation
No. of tree spp.	37	46	27	14	14
No. of shrub spp.	34	30	21	37	18
No. of herb spp.	28	38	26	23	24
No. of climbers	11	14	5	7	13
Orchids	5	5	2	0	1
Cultivated	–	4	3	5	9
Red listed[a]	8	8	3	1	–
H[b]	2.71	3.29	2.85	2.24	1.94
No of tree and sapling/ha	1,490	1,670	740	330	680
No. of tree seedlings/ha	19,375	19,000	8,125	3,812	5,875

[a] As per Khan et al. (2001)
[b] H—Shannon-Weiner biodiversity index

Fig. 8.5 Mammals and bird diversity in contrasting agroforestry land-uses and in forest

8.2.4 Ecosystem Carbon Storage

Soil organic carbon (up to 20 cm depth) and allocation of biomass carbon in different agroforestry land uses and in forest is given in Table 8.3. Biomass carbon was greater in betel-vine based agroforestry system (134.44 Mg ha^{-1}) followed by in forest (103.37 Mg ha^{-1}), lemon agroforestry (47.90 Mg ha^{-1}), shifting cultivation

Table 8.3 Biomass and soil carbon in different land-uses/cover

Variable	Land cover/agroforestry land use				
	Forest	Betel-vine agroforestry	Lemon agroforestry	Pineapple agroforestry	Shifting cultivation
Biomass carbon (Kg) in trees (in 10×10 m^2 plot, $d < 6$ cm)	898.90 (±834.1)	1169.04 (±645.13)	416.49 (±358.27)	86.50 (±120.23)	92.48 (±96.84)
Below ground biomass carbon (Kg) (in 10×10 m^2 plot, $d < 6$ cm)	134.84 (±125.12)	175.36 (±96.77)	62.47 (±53.74)	7.79 (±15.02)	12.48 (±14.38)
Total woody biomass carbon Mg ha^{-1}	103.37	134.44	47.89	5.97	9.57
Soil organic carbon in Mg ha^{-1} (up to 20 cm depth)	33.98 (±10.50)	30.36 (±8.92)	23.08 (±8.67)	19.94 (±3.58)	29.05 (±4.58)

Values in the parenthesis indicate the (±SD) under each sub-group

(9.57 Mg ha^{-1}) and pineapple agroforestry (5.97 Mg ha^{-1}) system. Soil organic carbon was however higher in forest (33.98 Mg ha^{-1}), followed by in betel-vine based agroforestry (30.36 Mg ha^{-1}) system, shifting cultivation (29.05 Mg ha^{-1}) and in others.

Tables 8.4, 8.5 and 8.6 shows the similarities of plant diversity, mammals and birds across different agroforestry land-uses as well as in the forest. Betel-vine based agroforestry system and forest shows the highest similarity (0.640, 0.529, 0.286), where the lowest similarity was observed between pineapple based agroforestry and between forest. The reason behind is, production of pineapple requires regular sunlight. Betel-vine agroforestry system supported comparatively higher number of mammals and birds than other agroforestry systems do supports, which even sometimes found superior than the forest. In case of ecosystem functions (i.e. carbon storage) betel-vine based agroforestry systems also shows the highest similarity with forest.

8.3 Conclusion and Policy Implications

It has repeatedly been argued by the conservation biologists that, the application of wildlife-friendly farming methods could potentially reduce the impact of agriculture on biodiversity (Green et al. 2005). In regions, where deforestation has

Table 8.4 Similarity matrix of plant species across studied land-cover/uses in Lawachara

Land-cover/uses	Betel-vine agroforestry	Lemon agroforestry	Pineapple agroforestry	Shifting cultivation
Forest	0.640	0.461	0.331	0.416
Betel-vine agroforestry		0.555	0.443	0.426
Lemon agroforestry			0.526	0.472
Pineapple agroforestry				0.440

Table 8.5 Similarity index of mammals across studied land-cover/uses in Lawachara

Land-cover/uses	Betel-vine agroforestry	Lemon agroforestry	Pineapple agroforestry	Shifting cultivation
Forest	0.529	0.529	0.467	0.261
Betel-vine agroforestry		0.467	0.636	0.462
Lemon agroforestry			0.500	0.462
Pineapple agroforestry				0.364

Table 8.6 Similarity index of birds across studied land-cover/uses in Lawachara

Land-cover/uses	Betel-vine agroforestry	Lemon agroforestry	Pineapple agroforestry	Shifting cultivation
Forest	0.286	0.154	0.081	0.135
Betel-vine agroforestry		0.194	0.067	0.214
Lemon agroforestry			0.210	0.136
Pineapple agroforestry				0.111

drastically affected original forests, and where poverty, unemployment and high population density is pervasive, traditional agroforestry systems can act as refuges for many species (Moguel and Toledo 1999; Bhagwat et al. 2008). From this study it was clear that in Lawachara area betel-vine based agroforestry system contributed to the conservation of biodiversity in greater extent than that of other studied agroforestry systems in that area, and could provide as much environmental benefits as by forests.

Park-people conflicts and limited access to economic incentives are common in tropical developing countries, which is not different in Bangladesh (Mukul et al. 2012, 2014; Rashid et al. 2013). The study demonstrates that, some of the indigenous agroforestry systems (here betel-vine agroforestry) could potentially be used in such context where conservation of biodiversity is critical. In tropical developing region clean development mechanism (CDM) and reducing emissions from deforestation and forest degradation (currently REDD + in short) is gaining wider recognition for rewarding small-holder farmers for any carbon offsets made by their land-use (Shin et al. 2007). The Government of Bangladesh through proper planning could use that opportunity which could provide twofold benefits, i.e. sustainable financing of conservation projects and cash support to small-holder farmer for their environmentally sustainable land-use practice.

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Chapter 9
Role of Co-management Organizations in Protected Area Governance: Some Observations from the Chunati Wildlife Sanctuary

A. Z. M. Manzoor Rashid and Niaz Ahmed Khan

Abstract The role of co-management in changing paradigms is very much a political process. This new framework can facilitate and enable greater local community engagement and institutional development. The positive outcomes of the co-management practice in Chunati Wildlife Sanctuary, Bangladesh are the primary grounding of the concept that managed to create zeal among stakeholders and the formation of legitimate local institutions. Initial enthusiasm was created with the initial involvement of the community in Co-management Council and Co-management Committee and was regarded as socially uplifting. The principles of participatory governance are also reasonably well reflected in legal and policy frameworks. However, the concept is still facing challenges in ensuring tenure rights, devolution of power, sustainable livelihood and active community participation in governance. Inadequacies in legal and policy frameworks, weak capacity building and livelihood support, a lack of motivation by the Forest Department in owning the concept and rapid expansion without sustainable financial mechanism are the main shortcomings of the governance of PA management. The critical issue raised during interviews with relevant stakeholders was the failure to implement prescriptions and plans developed for the better management of the Sanctuary. Lack of responsibility both from community and PA authorities was significant and the probable reason is the lack of efforts in owning the concept.

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M. S. H. Chowdhury (ed.), *Forest Conservation in Protected Areas of Bangladesh*,
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9.1 Introduction

Over the past decades, the threats to biodiversity have become an issue of global concern (Masozera and Ralavalapati 2004). The depletion of biodiversity is undermining conservation and development efforts, and obscuring the very notion of sustainable development (hereafter referred to as SD). Many approaches to biodiversity conservation have failed to attain the desired goals. Indeed, some actions have added momentum to the underlying causes of degradation—it is argued (see, e.g., Brechin et al. 2002). Bangladesh is no exception in this regard, where the situation has been further aggravated due to a population explosion, extreme poverty, over exploitation of natural resources, centralized and non-participatory style of decision-making, and a weak governance system (Sunderland et al. 2008). A good body of field-based evidence now exist to confirm that conventional conservation initiatives may have been detrimental to the local communities (Borrini-Feyerabend et al. 1998). However, in recent decades there has been a noticeable shift in the governance of natural resources in Bangladesh whereby decentralized, site-specific and community-led management activities are gradually taking the place of centralized 'classical approach'[1] to governance. The governance and the process of declaring protected areas (here after referred to as PAs) are now increasingly being recognized and accepted as an approach to active community engagement (Porter-Bolland et al. 2012). The distribution of management authorities to multiple institutions and stakeholders under co-management regime has become an emerging global trend.

Participation of local communities is proven to be decisive factor for PA management (Heritier 2010). PA governance is now widely based on such management principles as active stakeholder engagement and formulation and enforcement of joint decisions by, various actors. Under this view, the role of various stakeholders and appropriate local institution is accepted, encouraged and increasingly being embraced in various co-management projects (Brown and Kothari 2002). That community participation, combined with the application of local traditional knowledge contributes significantly in achieving the goals and objectives of SD is now unequivocally established and reflected through various regional and international legal and policy frameworks such as CBD, Agenda 21, the Aarhus Convention etc.

As PAs of late have attracted growing attention of the concerned practitioners, the public and the international community, it is necessary to evaluate the role of participation in their governance. Lack of ownership, ambiguous rights and access of the communities and effective community engagement are responsible for the poor governance of PAs (Rogers et al. 2008). Furthermore, legal and policy frameworks significantly influence the performance of initiatives towards SD including co-management of PAs. Such a pluralistic approach to the governance of

[1] Classical approach sees conservation as an isolated process whereby people are excluded and are not allowed to be involved in any kinds of activities within the conservation area.

PAs in the context of Bangladesh's calls for careful and critical consideration and review, as this approach is still in an experimental and nascent stage, and has yet to be grounded in the country's local institutional and social systems.

9.2 General Background

9.2.1 Community Participation and Protected Area Governance

Despite the repeated concern regarding participation, the extent of community involvement in participatory forestry programs has been insignificant. Broadly put, most of the past and present participatory forestry projects have managed to achieve physical targets but failed to meet social targets of community participation and equitable distribution of share and rights (Nath and Inoue 2010). Social forestry policy is designed, implemented and monitored without giving proper consideration and attention to the socio-economic context of the respective areas (Chowdhury 2005). Achieving SD through forestry requires a sound management process that would expand the forest resources and their sustainable use. The top-down approach is still persisting, ignoring the rich history of traditional practice and knowledge base. Recognizing the weakness of conventional forest management and the continued depletion and degradation of the forest resources, the government started establishing PAs. Since the 1980s, the Bangladesh government started establishing PAs in the national forests and gradually adopted legal frameworks for community participation in governance through co-management approaches.

9.2.2 Co-management Organizations in the PAs: The Functional Attributes

The co-management approach in the forest PAs in Bangladesh was initiated through the Nishorgo Support Project in 2003 (here after referred to as NSP). This initiative was eventually scaled up through the project named Integrated Protected Area Co-management (hereafter referred to as IPAC). The forest department (hereafter referred to as FD) is the legal custodian while local forest-dependent communities are the major local stakeholders engaged in the management of PAs (Chowdhury 2005). Co-management organizations (here after referred to as CMOs) lie at the center of the co-management system. The socio-economic dynamics in the rural setting are often dominated by rural elites; thus there has been a need for an institutional platform to safeguard the interest of the local poor

so that they can contribute significantly in the overall management and the decision-making process of the PAs (Chowdhury and Koike 2010). To pursue this objective two interrelated institutional platforms called the 'Co-management Council' and 'Co-management Committee' (hereafter referred to as CMC) have been established in five PA sites with a view to 'ensuring governance through local community participation'. The system including the institutions would eventually be scaled up through replication in other PAs in Bangladesh.[2] CMOs are represented by various stakeholders drawn from civil society, local government, local communities and resource user groups and relevant government agencies. The Co-management Council and CMC members and their responsibilities are defined through a Government Order as described in the Fig. 9.1.

Initially, the CMOs were not adequately representing the affected PA dependent communities and many argued for the restructuring of the CMOs (DeCosse et al. 2012). Accordingly a recent notification from the Government has provided for an increase in the number of the Co-management Council and CMC members from 55 and 29 to 65 and 29 respectively with a view to ensuring the greater participation of marginal and ultra-poor group members from the communities.[3] Several other tiers are also in existence at community level such as the Village Conservation Forum (VCF) and People's Forum (PF) and which are playing an important role in the formation and selection of the Co-management Council and the CMC. Selection of the Council and CMC members are done through a democratic process involving members from various tiers. The CMC is primarily responsible for the overall governance of the respective PA at local landscape level that also includes an area covering 5 km around the legal jurisdiction of the PA boundary (Chowdhury and Koike 2010). An Annual Development Plan (ADP) of the individual PA is now being prepared by the CMC under the active support of the project authority and the FD.

The CMC select Community Petrol Group (hereafter referred to as CPG) from local communities as per the guidelines to work closely and collaboratively with FDs to ensure protection of PAs. A provision has been made through a 'gazette notification' to utilise 50 % of the total revenue generated from various ec o-tourism based activities.[4] Various alternative income generating (AIG) activities are being undertaken by the NSP in collaboration with the CMCs to support local stakeholders by forming forest user groups (FUGs) in order to reduce pressure on forest resources, namely non-timber forest products (NTFPs) (Chowdhury and Koike 2010). However, the sustainability of CMCs still poses a key challenge since there are no regular and viable sources of funding to support management and development costs of the respective CMCs.

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[2] Bangladesh Gazette No. pabama/parisha-4/nishorgo-64/ (part-4)/112 dated August 10, 2006.

[3] Bangladesh Gazette No. pabama/parisha-4/nishorgo/105/sting/2006/398 dated November 11, 2009 and Bangladesh Gazette No. pabama/parisha-4/nishorgo-64/ (part-4)/112 dated August 10, 2006.

[4] Bangladesh Gazette No. pabama/parisha-4/nishorgo/105/sting/2006/138 dated April 2, 2009.

Terms of Reference of Co-Management Council and Committee, 2006

Co-management Council

1. Convene an annual general meeting and at least one meeting in addition to the annual general meeting.
2. Provide pertinent suggestions to the Divisional Forest Officer (DFO) on any modification, addition or correction after reviewing the annual work-plan of the protected area.
3. Take collective decisions on activities that have adverse effect on areas in and around the Protected Area.
4. Provide required guidance to the Co-management Committee on Protected Area management.
5. Develop policies for distribution of goods and services gained from the Protected Area among the stakeholders and also oversee such distribution among the stakeholders by the Co-management Committee.
6. Provide required approval to the Protected Area Annual Work Plan developed by the Co-management Committee.
7. Play an effective role in quelling any conflict that arises among the members of the Co-management Committee.

Co-management Committee

1. Act as the executive body of the Council and will be accountable to the Co-management Council for all their activities.
2. Liaise with FD officials responsible for management of the Protected Area on local stakeholders' participation.
3. Distribute the proceeds from goods and services from the Protected Area among the groups or teams linked with management activities according to the guideline developed by the Council.
4. Support Forest Department in employing labor from groups/teams linked with Protected Area management in development activities undertaken by Nishorgo Support Project for Protected Area Management.
5. Develop and submit project proposals requesting funds for development of the Protected Area and landscape zone.
6. Develop a work plan for expenditure of funds collected locally through Protected Area management and will ensure spending upon approval from the respective Divisional Forest Officer.
7. Maintain proper accounts of all local collection and expenditure from Protected Area Management. All accounts needs to be audited by institution/organization as directed by the Advisor.
8. Take required steps, upon approval from the Divisional Forest Officer, to initiate patrols for maintenance of Protected Area resources.
9. Play a supportive role in containing any conflict arising between local stakeholders and Forest Department or any other government/non-government organizations.

Fig. 9.1 Terms of reference of the CO-management Organisations under co-management regime (GoB 2006)

In the above backdrop, this chapter focuses on selected organizational and community dynamics of the Chunati Wildlife Sanctuary – a notable seat of experimentation with co-management in the country. The study draws on a fieldwork and systematic interviews of a range of primary stakeholders.

9.2.3 The Chunati Wildlife Sanctuary: At a Glance

The CWS, located at 21°40′N and 92°07′E, was established in 1986 under the Wildlife (Preservation) Act 1974.[5] The CWS is situated about 70 km south of Chittagong[6] city, covering an area of 7,763 hectares and offers a unique forested

[5] Gazette Notification of the Government of the People's Republic of Bangladesh, Ministry of Environment and Forest, No. XII/FOR-1/84/174, 18th March, 1986.

[6] Second largest city after capital Dhaka and the biggest port city of Bangladesh.

landscape with grassland, degraded forest, settlement and crop lands (IPAC 2009). Although the sanctuary originally supported mixed tropical evergreen and semi-evergreen forests, this has been degraded heavily over time. Massive encroachments have resulted in the conversion of forest area into agriculture land (mainly paddy and betel leaf cultivation) (Patwary 2008).

The sanctuary falls under the administrative jurisdiction of three Upazillas[7]: Lohagara and Banskhali Upazilla of Chittagong District and Chakaria Upazilla of Cox's Bazar District. Seven Unions[8] falls within the administrative boundary of the CWS: Chunati, Adhunagar, Herbang, Puichari, Banskhali, Borohatia and Toitong. The Sanctuary is bordered on the north by the reserved forests (RF) of Chunati Range and in the southeast and south by the RF of Chunati and Barabakia.

9.2.3.1 Demography and Livelihood in and Around CWS

Fifteen villages, having almost 70 settlements (hamlet/para) that are included in seven 'mouzas'[9] are situated in and around the Sanctuary. Among the 70 settlements, 24 are located within the sanctuary, 13 are located near the boundary and five are located within 5 kilometers from the boundary.[10] The total population in the area is about 21,428 (GoB 1996). The majority of the people are Muslim followed by Buddhist, Hindus and others. The illiteracy rate is higher than other regions (65 %). Among the literate category, 24 % are primary educated while 9 % are high school educated and the remaining 2 % are graduates. Madrasah[11] education is common among the girls.[12]

About 50,000 people depend on the CWS for resource collection. The primary occupation of the community living in and around the CWS is agriculture (mostly betel leaf and paddy cultivation), which accounts for 74 % of the total employment, followed by collecting fuelwood (10 %), day laborer (9 %), and others (2 %). The agriculture labourers are usually employed for only 6 months of the year and remain jobless for a substantial period of the rest of the year. As a

[7] Upazillas are under the jurisdiction of districts. It is the lowest tier of formal government administration.

[8] The lowest administrative unit of local government in the rural areas of Bangladesh.

[9] Mouzas are the lowest revenue collection unit created during Mughal regime. Currently they are denoted more as social unit than revenue collecting unit. See Banglapedia-National Encyclopaedia of Bangladesh, URL http://www.banglapedia.org/httpdocs/HT/M_0338.HTM, last accessed on May, 13, 2012.

[10] Management Plans for Chunati Wildlife Sanctuary Volume-1 (Nishorgo Support Project, Bangladesh Forest Department, 2006) 12.

[11] Muslim educational institution specialized in Arabic language and Islamic studies. It derived from Arabic word *darsun* meaning lesson. See Banglapedia-National Encyclopaedia of Bangladesh, URL http://www.banglapedia.org/httpdocs/HT/M_0338.HTM, last accessed on May,13, 2012.

[12] Site Information Brochure: Chunati Wildlife Sanctuary-Saving Nature for Future Generations, NSP, and USAID.

consequence, the biotic[13] pressure on the CWS is significantly high, which also affects the wildlife conservation and management of the Sanctuary (BFD 2006).

Land encroachment is a big problem in the study area. Encroachment of forest land for agriculture, betel leaf cultivation, brick field and settlements, both in temporary and permanent forms, is common inside the CWS. Betel leaf (*Piper betel*) cultivation is widely practiced in the study area by the local people as a major means of livelihood (DeCosse et al. 2012). Encroached forest lands are widely used for this purpose. A large number of veins[14] have been established inside the CWS, particularly in Chunati, Aziznagar and Harbang forest beat. Bamboo stakes, sun grass and other forest materials used for fencing and roofing are cultivated and extracted from the CWS. Saw mills and brick fields are the two major threats, after betel leaf, for the continued destruction of the forest resources. The wood is used for furniture making as well as for burning in brick kilns. Four brick fields owned by the local elites in and around the Sanctuary were observed during fieldwork.[15]

9.2.3.2 Ecology and Local Livelihoods in and Around CWS

The CWS originally supported mixed tropical evergreen and semi-ever green forests that have been substantially degraded due to biotic interference. Such interference has resulted in fragmented habitats that badly affect the general ecosystem and wildlife (BFD 2006). Various tree species are also becoming extinct at an alarming rate, making the whole Sanctuary vulnerable in its ability to support biodiversity.

The CWS and the surrounding landscapes include terrestrial, aquatic and forest ecosystems and a wide range of plants, animals and micro-organism were observed during the field research. A typical ecosystem has developed in CWS influenced by predominant edaphic and microclimatic factors.[16] It belongs to humid mega thermal (MAT $\geq$ 22°) climate, with little or almost no water deficit. The temperature varies from a minimum of 14° in January to a maximum of 32° in May. Humidity is high; with an annual average rainfall of approximately 3,000 mm. Maximum rainfall occurs during June to September, from the south-west monsoon. Five broad ecosystems (habitat types) have been identified in the CWS and its interface landscapes. They are:

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[13] Biotic components are the living things generally exert influence on ecosystem. Here it denotes the impact of human being affecting the ecosystem of the CWS.

[14] The cultivation of betel leaf is called veins which are locally known as *barouj* fenced with forest materials. It is a creeper plant belongs to *Piperaceae* family.

[15] This group of people are backed by political parties directly or indirectly thus hold enormous power to influence government machineries.

[16] Rainfall, humidity, aspect, sunshine and soil factors are among the major microclimatic factors. See for details Management Plans for Chunati Wildlife Sanctuary Volume-1, above n 26, 6.

Fig. 9.2 *Dipterocarpus* plantation inside the protected area

Fig. 9.3 Betel leaf (*Piper betel*) cultivation with enclosed structure inside the protected area is a common scenario

- Remnant of secondary forest
- Forest plantations (Fig. 9.2)
- Grassland and bamboo
- Wetlands and water bodies
- Crop fields (paddy, betel leaf, and seasonal agri-crops) (Fig. 9.3)

9.2.3.3 Co-management Interventions in the CWS

The CWS was declared a PA in 1986 but the collaborative governance process, with multi-stakeholder arrangements, began under the tenure of NSP. Currently the co-management experiment is being continued under the auspices of the project titled Climate Resilient Environment and Livelihood (CREL). The project pursues the following original goals: promoting the co-management of biological

resources for conservation and community development. So far, two CMCs have been formed as part of this new process.[17] These two CMCs consist of 60 Village Conservation Forums (VCFs), two People's Forums (PFs) and 12 Community Petrol Groups (CPGs). IPAC is focusing on sustaining the CMCs, facilitation of the capacity building of VCF, PF, CPG and other stakeholders.

9.2.3.4 Formation of the Co-management Organizations: Their Role in Governance

Institutions are vital for ensuring community participation and enabling an environment for sustainable PA management (Pyhala 2002). It is therefore imperative to determine the strength and weakness of the institutions involved in the process. The Forest Department is the major state institution responsible for the management and development of forests. The department's original mandate was to increase revenue and maximise the profit, which seemed to be a continuation of colonial trend (Larson and Ribot 2007). For many years, in line with other Asian nations, community engagement was not in the mainstream discourse and practice of the state–led NRM. However, with time, the context and scenario have changed, resulting in the recognition and acceptance of community participation in conservation (Reed 2008). The FD, with the active support of the community, is now playing a central role in managing forest PAs with the objectives of poverty alleviation and biodiversity conservation. There has also been a degree of recognition about the importance of transparency, accountability and other principles of good governance as preconditions for the active community participation amongst the concerned quarters, and this broader realization has been reflected in some national and international laws and policies (particularly in regard to the Aarhus Convention).[18] In the context of co-management, it followed that there was a need to develop effective local institutions (Faizi 2006). Equitable and efficient distribution of resources and cost and the benefit-sharing mechanisms required the umbrella of these institutions. Therefore, the FD created legal frameworks to establish various CMOs through the representation of key stakeholders in the overall management of PAs.

The co-management council and committee are the two major institutions established to plan and enforce decisions jointly in the governance of PAs. The formation of these organizations takes place through various phases depicted through the schematic presentation of Figs. 9.4, 9.5, 9.6.

The number and the assortment of members vary between the Co-management Council and the CMC.[19] The overall activities of the CMC are supervized by the

[17] Bangladesh Gazette Order No. pabama/parisha-4/nishorgo/105/sting/2006/398.

[18] It is the convention on access to information, public participation and access to justice on environmental matters. See for more details http://www.unece.org/fileadmin/DAM/env/pp/documents/cep43e.pdf.

[19] See for details Gazette Notification No. pabama/parisha-4/nishorgo/105/sting/2006/398, dated 23 November, 2009.

Fig. 9.4 Schematic presentation showing different phases of the formation of Co-management Organizations

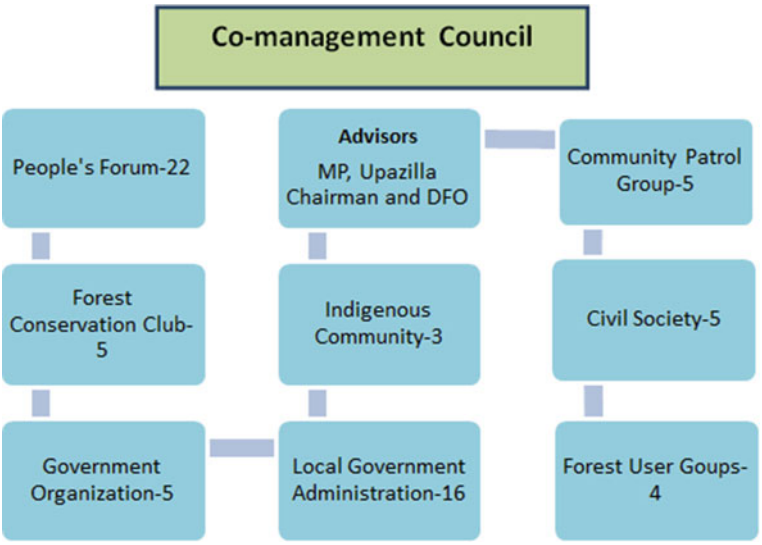

Fig. 9.5 Diagram depicting the structure of the Co-management Council along with stakeholder type

Co-management Council and formal approval of the council is required in formulating management plans. The following diagrams described the structure of these two organizations based on the number and types of stakeholders' involvement.

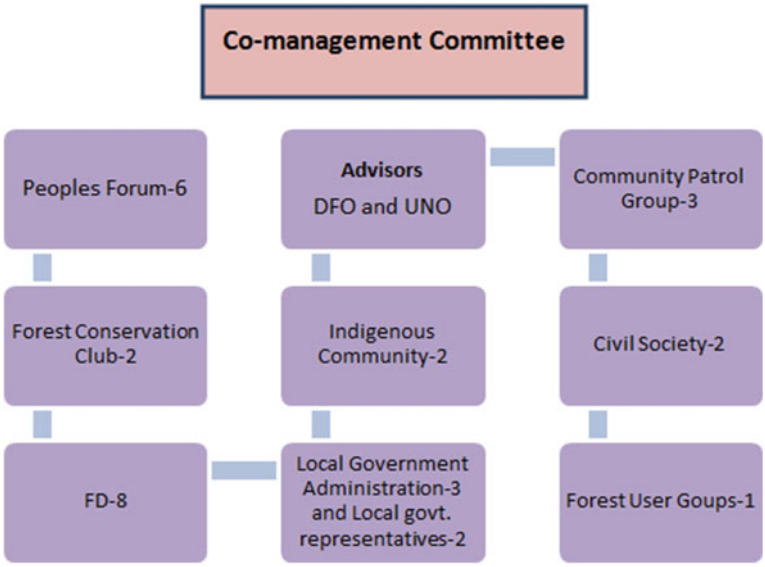

Fig. 9.6 A diagram depicting the structure of the Co-management Committee along with stakeholder type

9.3 Major Outcomes of the Analysis

9.3.1 Sustainability Issues of Co-management Organizations and Their Role in Achieving Sustainable PA Management

Sustainability (particularly as legitimate participatory institutions) and the financial viability of the CMOs are crucial in achieving conservation and development goals. They act as active partners of the FD to improve PA governance. Incidents of illegal felling have been reduced considerably with their active involvement. Some members of the community, who had been engaged in illegal logging joined the community patrol groups (CPG) and became involved in the protection work. This transformation is seen as good 'success story' for a local institution such as the CPG and serves as a motivational examples. How the respondents viewed the sustainability of the co-management organisations is evident from their responses:

> … The CMC need its [own] source of funding to sustain and meet day to day expenditures. It needs some form a 'seed money' like Management of Aquatic Resources through Community Husbandry (MACH) Project sponsored endowment fund… Massive scaling of the co-management programme is squeezing the budget to individual PAs. It is [seriously] limiting the funds and management efficacy of the individual CMC … this is not a

> good start [planning]. Donors support will be withdrawn in near future … how will they survive? … need to think right from the beginning.[20]
>
> …we need to explore income generating activities to sustain CMCs and their members to be involved actively. How can you expect my time, effort without taking care of my livelihood? … we also need to reduce too many tiers in the organizational process … this is just creating more gaps and diluting the responsibility in between.[21]

CMCs and other related institutions need to take care of community interests. Efforts are underway to register all the CMCs with the Government's Social Welfare Department to enable them to secure funds and other support independently in the long-term. Such self-reliance may also reduce the forest dependency of the community by their engagement in various projects implemented by CMCs.

However, some interviewees had quite different views in this regard and urged attitudinal change and knowledge development of the community, CMC and relevant stakeholders. Ensuring equity is crucial to achieving these goals. Local political influence is also a growing concern and they insist on attention to this issue right from the planning stage of the project.

9.3.2 Institutional Attributes of the Co-management Organizations: Capacity Building and Legal Frameworks

Without developing the capacity (of both the service provider and the receiver), it is hard to attain the desired goals in co-managed PAs. Some respondents mentioned inherent problems in the CMC structures and member selection process, while others praised its democratic nature and legal cohesiveness in addressing community participation. The following are some of the perceptions expressed in favour, or against, the institutional functionality of co-management organisations that can be taken into consideration for developing a better framework:

> … there are inherent problems in the CMC structure. You will see many local elites [connected with major political parties] and government [FD and others] officials as the play maker. It is overshadowing the voice and existence of grass root people. We want to see FD as service provider not as administrator any more. We also need to ensure sustainable funding of CMC. But what we see now is the dependency on donors and FD. This will not help achieving sustainable PA management in the long run.[22]
>
> … the legal framework of the co-management council and committee still provides room for influential to be selected. You will find offenders [involved in forest destruction] in the management committee [council members] … how do you expect better governance with the people [such as furniture proprietor, brick field owner] who are behind the scene of destruction? … this is just an eye wash… biodiversity will continue to be destroyed and

[20] Interview with DP3 (face to face, 8 January 2011).

[21] Interview with ED2 (face to face, 15 December 2010).

[22] Interview with DP4 (face to face, 21 September 2010).

community will suffer. We do not have any long term vision in sustaining any programme so as co-management.[23]

According to some respondents, the existing structure of the CMC does not reflect the true participation of forest user groups, although the numbers and size of membership are quite significant. The actual power and voice still appears to remain with the bureaucrats, elites and professional representatives. Some people interviewed urged a revision of the legal and policy frameworks to improve the implementation process of the co-management in Bangladesh:

…existing mechanisms are not transparent in briefing legal issues to community. They need further orientation to update and inform legal aspects, rights, responsibilities and related governance aspects. PA Rules (if formulated) can overcome many of the existing shortcomings of co-management.[24]

… inclusion of members in the CMC is not a problem but the functionality and the legal basis is a [big] concern. It [functionality] depends on timely release and transformation of specific rules, orders.[25]

… legal framework is quite democratic in nature. CMCs are now formed through election and with the scope of registration as a social organisation they can work independently… I think it's a good progress. The more the people you deal, the better the chance of reducing conflicts through mutual understanding… so the large number of people in co-management council and committee is quite logical and a positive step forward.[26]

The key concepts of co-management have been reasonably developed in Bangladesh law and policy, particularly under the revised *Forestry Act, 1927*.[27] The project now needs to move beyond the limited pilots and programs to develop a robust national PA system based on the effective implementation of co-management approaches. Some respondents believed that CMOs are dealing with more focused issues, so there is less chance of conflicts among the stakeholders. With the initiative of developing the Nishorgo Network, CMOs will benefit through the sharing of views, experiences and operational policies. There is also a need to develop strong community cohesion with the ability to articulate their aspirations and needs through their CMOs. Legal and policy frameworks need to address community and ecological demands together. In the long run, this will also increase their social recognition and support. The following quotations highlight the importance of these issues:

…regular updating [which is a continuous process] of laws, acts and regulations is important. Recent amendment of the *Social Forestry Rules 2004* is a positive outcome… we have to create confidence among the participants. Law is one instrument to do so.[28]

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[23] Interview with DP5 (face to face, 26 December 2010).

[24] Interview with PA2 (face to face, 21 September 2010).

[25] Interview with DP1 (face to face, 3 February 2011).

[26] Interview with PA2 (face to face, 8 December 2010).

[27] Section 28 and 28A of the Forest Act 1927 (amended up to 2000). See Rahman, above n 45, 18.

[28] Interview with PA3 (face to face, 21 December 2010).

… to make co-management a success you have to engage CMC as a partner and share the legal disputes related to forests and PAs. Forest offences and cases should be discussed in CMC meeting and suggestion should be sought to win over people engaged in unlawful activities in and around the PAs.[29]

9.3.3 Devolution of Power to Co-management Institutions

The devolution of power is a dynamic and radical initiative compared to 'decentralization' as it delivers the authority from one agency (mostly state) to a completely new one i.e., in particular an organization of local origin (Borrini-Feyerabend et al. 2007).[30] The local context of participatory environmental management is a positive strength in terms of devolution of power (Kapoor 2001). Devolution of power is believed to increase community participation towards promoting equitable and efficient forms of management with effective decentralization (Ribot 2003; Selman 2004). Co-management, to be successful, requires local power and capacity to exist and perform. In this regard, community organizations like the Co-management Council and CMCs can play significant roles if properly resourced devolution of power takes place and it is exercised as efficiently and fairly as possible. How respondents perceive the changes towards decentralization and devolution of power was discussed by interviewees and their responses provide an insight into this issue:

… it is [still] a top-down approach [except in paper]. The earlier success [achieved during NSP] is redefined to claim success… in one side inputs are negligible compare to demand while on the other side there are instances of abuse and exploitation by some [influential] CMC members… the glowing example is the value chain programme whereby money and resources were [simply] expended without having any prior need assessment and monitoring system.[31]

… CMC as a local institution has not yet been accepted by the community as their own entity. As long you do not own the identity how can you work for that?… such change cannot be identified as devolution of power'.[32]

… it is [co-management project] like a step child of FD. They [FD] are less proactive in this programme. The PA staffs believe their posting in the PAs as punishment… you cannot expect anything out of these mentality and orientation… furthermore; lack of trust between CMC and FD is adding fuel to it'.[33]

[29] Interview with PA4 (face to face 10 October 2011).

[30] Borrini-Feyerabend et al., above n 95, 357.

[31] Interview with PA6 (face to face, 26 October 2010).

[32] Interview with PA7 (face to face, 24 October 2010).

[33] Interview with PA8 (face to face, 9 December 2010).

9.3.4 Conflicts in the CMC and Their Impacts on PA Management

Local politics significantly influences the formation and management of the CMCs. Manipulation in beneficiary selection, illegal logging and instances of encroachment inside the PA were on some occasions, patronized by local elites and political leaders. In many cases, local elites were found directly responsible for the encroachment and this was discussed during CMC meetings (i.e. 41st and 42nd meetings of the Chunati CMC). Another major issue raised through the meetings was the conflicts between the FD and local communities. Both parties blamed each other for the illegal activities taking place inside the PAs. For example, the FD was blamed by the CMC for allowing a private company to harvest palm oil seed in one national park without informing CMC at the Satchari National Park.

9.4 Discussion and Policy Implications

Monitoring systems to evaluate the achievements of co-management appeared to be absent in the processes and guidelines developed so far. Managers and practitioners failed to develop indicators to evaluate governance. Inherent problems in the structure of Co-management Councils (headed by the political and government structure) may also be overshadowing the voices and the needs of the grass-roots poor. The community needs to be in a leadership role and the FD as service provider, particularly for technical and operational support. Logistic and adequate human resources are the two major elements that play important roles in governance since constant and appropriate monitoring and supervision are required to ensure efficacy and performance of the institutions engaged in the process. There is also an urgent need to integrate co-management concepts with other government services and program to ensure community demands, i.e. that livelihoods, biodiversity conservation and sustainable development of PAs are properly and consistently addressed. The following responses provide suggestions for further development in this regard:

> FD has to play the leading role in fostering co-management… they need to change their management systems [command and control]. Despite of leadership crisis at different levels there are critical masses among FD officials to accept the new concept. Relevant ministry has much to do in creating good governance. Image is a crucial aspect of governance… FD needs to be more concerned about this. Individual and institutional trust must be ensured among CMC, FD and ministry.[34]
>
> … beneficiary selection is a challenging task to bring actual forest users into the management system while devising AIG activities. In case of present project it is not done

[34] Interview with DP6 (face to face, 12 October 2010).

> properly. Partner NGOs are using [their] conventional techniques [which they often use for micro-credit programme]… natural resource is [completely] a different perspective… it needs vision and massive awareness in support of conservation.[35]

However community participation itself may not be sufficient to make community-based environmental management a success. States also needs to develop property ownership systems that establish community rights over the resources they depend on (Kapoor 2001). To be effective, community participation needs supportive legislation, suitable methods, access to information and resource and economic benefits to the local communities (Wang and Lees 2011). Furthermore, the existing laws need to be equally and uniformly enforced or implemented to reap the benefits of decentralization and devolution of power.

The positive outcomes of the co-management practice are the primary grounding of the concept that managed to create zeal among stakeholders and the formation of legitimate local institutions. Initial enthusiasm was created with the initial involvement of the community in Co-management Council and Co-management Committee and was regarded as socially uplifting. The principles of participatory governance are also reasonably well reflected in legal and policy frameworks. However, the concept is still facing challenges in adequately addressing issues of tenure rights, devolution of power, sustainable livelihood and active community participation in governance. Inadequacies in legal and policy frameworks, weak capacity building and livelihood support, a lack of motivation by the FD in owning the concept and rapid expansion without sustainable financial mechanism are the main shortcomings of the governance of PA management. The critical issue raised during interviews was the failure to implement prescriptions and plans developed for the better management of the PAs. Lack of responsibility both from community and park authorities was significant and the probable reason is the lack of efforts in internalizing and owning the concept.

Globally, over the last decade, the concept of collaborative management has had positive impacts on PA governance. This governance approach enhanced the scope of decentralized, site-specific and community based activities and decision-making processes as compared to centralized management approaches (Kothari et al. 1998). Of late, Bangladesh has responded to this development by introducing co-management in the forest PAs with a view to ensuring sustainable conservation and development by involving communities through CMOs. The nature and extent of this paradigm shift in the governance of PA management is based on the perception and experiences of the stakeholders through a case study carried out in the Chunati Wildlife Sanctuary (CWS).

Participation takes place when communities have the control, delegated authority and a good form of partnership under any formal and informal community organizations. In the case study, various platforms like Co-management Councils and Co-Management Committee, Village Conservation Forums (VCFs) and People's Forums (PFs) were established to enhance and ensure community

[35] Interview with DP3 (face to face, 8 January 2011).

participation. An initial breakthrough took place that increased social status, zeal and eagerness to participate in the management process. Some respondents viewed their engagement in co-management as a means of improving their social status and this significantly influenced others to become a part of the process. Awareness of conservation and sustainable development issues were enhanced due to the active participation in legitimate institutions such as CMCs. However, the basic goals and objectives of the concept often remained elusive and obscure among other organizational tiers (particularly VCF and PF), indicating the inappropriateness of the needs assessment survey and stakeholder analysis at the initial stage of program implementation.

Assuring legal recognition of lands and resources is also crucial in ensuring active participation as demonstrated by co-management in many countries such as Australia. Handing over of custodianship of the part of PA or the buffer zone to CMCs can be effective in creating the sense of ownership over PAs and to minimize the intra-conflicts between community members.

Co-management as a shared governance approach constantly requires essential support in the form of technical and financial resources, particularly at the initial stages. Enabling efficient local institutions and empowering communities are important tools to develop skilled people and organizations for PA governance. However management programs and institutions, such as the CMCs, need sustainable, continuous and predictable sources of funding and assistance. Provision of endowment funds to attain self-reliance is very important in this regard.

Capacity building of local institutions and individuals has direct relevance to the sustainability of PA management. Ensuring SD and meeting local community needs requires that extra attention be given to empowered and efficient local institutions. CMOs are the nucleus of the PA management and careful consideration in selecting members is required. With the recent amendment (government order) the numbers of members and member selection criterion have been changed. However, inherent problems of the CMC structures are still favoring the dominance of local elites and the government (FD) officials, as mentioned in other studies (Rashid et al. 2013). The terms of reference (ToR) for the Co-management Councils are somewhat ambiguous and responsibility is diluted among various actors. However, some case study respondents considered that the increased number of CMO members was a positive initiative in reducing conflicts through improved and mutual understanding. The provision for registering CMOs in the Social Welfare Department has also creates scope for harnessing funds from external agencies. The proposed PA advisory board can be a focal point in helping CMC to get connected with the donors.

9.5 Conclusion and Recommendations

Making synergy between conservation and development is always challenging, as described in many studies and the discourse on SD (Brown 2002). The interconnectivity of international legal and policy frameworks, and the basic attributes of

SD, are not well reflected in the policies and practices of PA management in Bangladesh. Growing social, political and environmental challenges can only be minimized through adaptive and long term strategies. There are also be significant differences in the design and implementation of co-management governance in developing nations, as compared to developed nations. Nations such as Bangladesh require much greater attention to the role of local communities and SD strategies are a vital and integrated part of PA governance and which is currently evident in international laws, guidelines and 'best practices' in the co-management approaches of developed nations such as Australia (Jeffery 2004).

A careful integration of different yet complementary strategies may be useful for a more resilient and robust PA governance approach for Bangladesh. In this case, poverty alleviation through livelihood creation, equity in benefit sharing, recognition of tenure rights, shared governance that involves the devolution of power to transparent participatory local institutions in accordance with the principles of SD and capacity buildings are the key drivers.

A detailed assessment of local site-specific needs and demand is imperative to be done to understand the specific underlying problems and requirements for each PA, instead of applying the proto-type mechanisms. Additionally, co-management institutions and their processes need adequate and long term funding and strategies to improve their capacity to represent and empower communities and deal with the vested interest of elites.

A clear plan of research, organizational and operational development is needed for each unique PA. The overview of past and current legal and policy regimes for participatory governance of NRM (particularly forestry) and PAs in Bangladesh shows that a promising framework is emerging towards enabling a co-management regime. However, it is still far from integrated, comprehensive or consistently reflective of SD principles and objectives.

A key reason for the focus on legal, policy and institutional dimensions of co-management is the magnitude of the governance challenge, in Bangladesh, to overcome these problems and limitations. International experience indicates that participatory, transparent and legitimate local institutions and processes can be facilitated by legal and policy change. This is a clear role for government leadership and political commitment.

The role of co-management in changing governance paradigms is very much a political process. These new frameworks (notably co-management) can facilitate and enable greater local community engagement and institutional development, and must be allowed sufficient time for local grounding, community ownership, and contextual adaptation. Community development and SD gains need to be guarded against encroachment by vested interests and institutionalization. This requires a living political culture with strong enduring commitment by local communities and associated key stakeholders. Bangladesh requires legal and policy frameworks that are appropriately designed and implemented to allow communities to develop their own specific forms of forest PA governance.

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Chapter 10
A Review Discussion on the State of Collaborative Protected Area Management Around the World and Comparison with That of Bangladesh

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Abstract In many cases throughout the world, the establishment of protected areas has failed to achieve the desired outcomes due to a purely ecological focus and a poor recognition of local peoples' rights and involvement. Therefore, various modes of community conservation have become important alternatives to government protected areas; the approach of collaborative management or co-management has come to be widely practiced. Such management approach has been implemented in more than 60 countries with the main objective of promoting sustainable development and biodiversity conservation. In most of the cases, it came out with optimum success, and in others, it could not fully meet the program goals. The co-management program showed its success in the protected areas of Bangladesh, both in terms of community development and biodiversity conservation, as described in the previous chapters. This chapter discusses the continent-wise status of co-management in other countries of the world and a brief comparison was made with that of Bangladesh with a case study analysis of local communities' views about the impact of co-management on the wildlife status of Rema-Kalenga Wildlife Sanctuary.

10.1 Introduction

The growth in the number and coverage of protected areas over the last 130 years has been remarkable. As of 2011, the world's protected areas encompass more than 21 million km^2 (WCMC 2011), an area the size of Russia, India and Afghanistan combined. The current total coverage for terrestrial areas is 12.9 % and for territorial marine areas is 6.3 %, and this growth continues each year (Ervin 2011). There have been several shifts in the way that society has envisioned

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M. S. H. Chowdhury (ed.), *Forest Conservation in Protected Areas of Bangladesh*, World Forests 20, DOI: 10.1007/978-3-319-08147-2_10,

protected areas over this period, from a classic model in the 1800s through the 1970s, where protected areas were established and managed for scenic and recreational values; and from a modern model from the 1970s through the mid-2000s where protected areas were established and managed for scientific, economic and cultural reasons, to an emerging model where protected areas are expected to maintain critical life support services and contribute to sustainable development (Ervin et al. 2010). Throughout the world, 34 biodiversity hotspots were identified that deserve high priority for conservation; 20 of them lie in tropical countries, which for the most part, face the gravest threats to their natural resources and have the most limited wealth for conservation (Das et al. 2006). Though protected areas have grown considerably over the last 130 years, there are several troubling trends, including national and regional disparities, ecological gaps, a decline in the growth of new protected areas, and problems with ineffective management (Ervin 2011). Biodiversity conservation is one major objective in protected area planning, which may be implemented to conserve populations, species, or genetic diversity (Naro-Maciel et al. 2009). While biodiversity loss has recently been considered a comprehensive global environmental challenge (Cuthbert 2010; Cardinale et al. 2012; Krause and Zambonino 2013), protected areas symbolize a globally prevalent approach to stem this loss (Shahabuddin and Rao 2010). However, despite the evidence of their efficacy for conservation (Naughton-Treves et al. 2005), the concept of protected areas faces difficult challenges and dilemmas interrelated with rural livelihoods and biodiversity conservation (Holmern 2003). The key challenge arises from the exclusion of local people from areas under protection that has been an all-too-common narrative (Adams and Hulme 2001; Oli et al. 2013), with many strategies focused on protection of ecosystems from the communities' destructive subsistence and livelihood activities (Ogra 2012). The creation of many protected areas has led to the exclusion of local people who previously had had access to the resources therein (Holmern 2003); local managers are often referred to as 'guards', which ensures that they are perceived as being in direct opposition to local people. Conservation strategies commonly conflict with local livelihoods when local people are forced to use resources outside the conservation areas (Salafsky and Wollenberg 2000) or attempt to access resources within conserved areas illegally. It is essentially impractical to exclude local people from protected area systems when protected areas embedded in human-dominated landscapes are the norm in most parts of the world (DeFries et al. 2010). Many conservationists working in developing countries consider conservation in protected areas to be unsustainable unless local communities become an integral part of their management (Infiled and Namara 2001). Therefore, it is now increasingly recognized that protected areas should play roles in sustaining the livelihood of adjacent local communities (Charnley et al. 2007) which have important and long-standing relationships with these areas. McNeely (1990) pointed out that local people's needs, aspirations and attitudes should be considered in protected area management; otherwise, long-term survival of protected areas will be jeopardized. Consequently, various alternative approaches to conservation have been suggested, the most popular of which include collaborative governance arrangements and combining conservation and

development within projects (Oli 1999). The development of management partnerships, termed collaborative management or co-management, involving all the major stakeholders, is a relatively well-recognized management approach to reconcile cultural and biodiversity conservation in protected areas (DeKoninck 2005; Berkes 2009). The trend is away from exclusive management models towards inclusive models that involve a high degree of local participation, recognize the links between nature and culture, and employ collaborative approaches that incorporate the traditional resource rights of local communities (Phillips 2002). There has been the moral argument underlying this to the effect that conservation goals should contribute to, rather than conflict with, basic human needs (Mahanty et al. 2007). Purnomo and Mendoza (2011) cited this policy as the most viable option of protected area management that leads to a win–win situation for all the stakeholders involved. Also, collaborative and community-based monitoring are important parts of co-management approach. It can lead to shared ecological understanding among diverse participants, build trust internally and credibility externally, foster social learning and community-building, and advance adaptive management (Fernandez-Gimenez et al. 2008).

10.2 Global State of Protected Area Co-management

10.2.1 Asian Region

People-oriented approaches to forestry have emerged and matured in Asia since 1970s—variously described as community forestry, community-based forest management, social forestry and joint forest management. The initial focus on involving communities in government programs for reforestation and forest protection has gradually evolved towards more devolution of decision-making power and more active use of forests by the local communities (Fisher et al. 2007). As a thriving and developing democracy, and progressive for conservation and social causes, India has implemented a national eco-development program that strives to improve socioeconomic conditions of local communities and conserve natural resources (Srivastava and Heinen 2007). The stakeholders of the Devi Ki Rao watershed in Jainti, India, are managing the community-owned forest for sustainable production that results in the phenomenal increase in the income of beneficiaries from the sale of forest products (Grewel et al. 2001). Kent et al. (2012) explored the success of the engagement of local villagers in developing adventure tourism in Nanda Devi Biosphere Reserve, India, in terms of sustainable livelihoods for community and conservation of the biological diversity. While the existing network of protected areas in the Western Ghats has a good representation of the ranges of several threatened and endemic species, it does not effectively conserve certain taxa, particularly amphibians, tree species of evergreen and semi-evergreen forests and small mammals. These groups have high rates of

endemism and must be adequately conserved within this region for their chances of persistence to be assured at a global level (Das et al. 2006). In Khakaborazi National Park of Myanmar, hunting for trade declined to approximately half the original level and over-harvesting of forest products has declined by 30 % two years following the conservation project initiation due to a number of reasons, including successful advocacy by the project and local people's support (Rao et al. 2009). The co-management of aquatic resources, including fisheries, has apparently succeeded in increasing fish stocks, and villager fish catches, in Khong District, Champasak Province, southern Laos (Baird 2000). In China, traditional pastoralist communities have long inhabited vast areas of western region, including the Tibetan Plateau. They have been involved in conservation programs by forestry authorities, and their consequential contributions on wildlife conservation efforts are evidently significant (Foggin 2012). Co-management of the sand eel fisheries in Ise Bay is a famous case in Japan, where natural resource management is carried out through the interplay of fisher communities, science, and government (Ashida 2009). As the partners of co-management programs, local communities in the Philippines have been exercising a more democratic process in forest management planning and decision making (Hartanto 2007). Accordingly, the Philippines' policy of community forestry has been described as one of the most innovative in Southeast Asia, and the designed transfer of rights over forest resources to communities has been called impressive (Colchester 1994). Because of the widely recognized feasibility of co-management approach in monitoring the natural resource management activities, the approach has also been introduced in Sri Lankan forested fisheries (Degen 1998; Amarasinghe and De Silva 1999).

The vast Indonesian archipelago contains nearly a third (32 %) of the rainforest of South and South-east Asia that plays a range of critical roles such as providing ecosystem services for rural communities, maintaining biodiversity and regulating climate change. Unfortunately, Indonesia, and in particular the western island of Sumatra, has some of the highest annual rates of tropical deforestation in the tropics (0.2 % loss per year), which makes it the world's third largest carbon emitter (Measey 2010). Therefore, in an attempt to curtail forest loss the Government has taken various schemes pledging to reduce its carbon emissions by 26 % over the next 10 years. A mosque-based environmental-themed Ramadan campaign comprising a sermon is one of the efforts that considerably raised levels of concern amongst all respondents in West Sumatra (McKay et al. 2013). On the contrary, since decentralization in forest management was implemented in Indonesia, many local governments have regarded conservation and protected areas as a burden for their areas, hindering development and not as a valuable asset important for long-term development (Wollenberg et al. 2009). Their vision of development is based on narrow economic considerations and, it is difficult to convince local government decision makers of their importance. As the case of Kutai National Park shows, the valuation of the ecosystem services are far outweighed by direct other economic uses of the area. The valuation does not capture important 'ecological values'—the whole range of values that humans derive from ecological systems, including services, provision of material resources, aesthetic

values attributed to pristine and/or healthy systems, recreation, spiritual, and the biodiversity with potential value (Limberg et al. 2013).

The co-management of protected areas in Nepal has progressed rather well when compared to other South Asian countries particularly in terms of establishing enabling policies, legislation and institutions with successful examples as buffer zone management projects and conservation area projects (Nagendra et al. 2005). For example, Baral and Heinen (2007) reported the successful story of decentralized participatory conservation in Bardia National Park, Nepal. By analyzing aerial photographs and forest inventory data on forests in the Middle Hills of Nepal, Tachibana and Adhikari (2005) found a significant increase in tree regeneration as a direct impact of co-management. The Community Forestry Program in Nepal is considered a world leader in the field of collaborative environmental governance. Despite the success of Nepal's program in formally handing over rights to thousands of local forest user groups, however, it has not yet fulfilled expectations regarding increased returns to forest users and regarding equity in governance and in the distribution of management burdens and benefits (McDougall et al. 2007)

10.2.2 African Region

The designation of strict protected areas in Africa has created much conflict with local communities with the need to find a balance between resource use and preservation of nature (De Boer and Baquete 1998). As a response to these needs some protected areas allow for various kinds of access to local people living around them (Dudley 2009). In countries where communities have ownership of land and legal rights to provisioning services, communities are opting to collaborate with conservation organizations in order to derive win–win outcomes through co-management programs. This has become an attractive approach to land management around Africa (e.g., Kenya, Namibia, Mozambique, Tanzania, Zambia, Zimbabwe), and aims to improve the socio-economic situation for rural communities, and to maintain or improve the natural resource base through sustainable land use management. Zimbabwe's CAMPFIRE, developed in the mid-1970s, is both a rural development and a conservation program and is considered the pioneer of community-based natural resource management (CBNRM) initiatives in southern Africa (Nelson and Agrawal 2008). Since then, the number of conservancies has increased following the income this approach has generated for communities with high wildlife value and tourism potentia. By 2010, at least 50 CBNRM institutions were present in Namibia (Suich 2008). Recent research in such a conservancy (Salambala Conservancy) suggests an increase in wildlife and tourism activities since the initiative began. The surrounding community admitted that the conservancy is generating benefits to local communities, and they want the conservancy to continue. The establishment of the conservancy has boosted tourism with positive effects on sale of local products such as baskets and mats.

These types of resource management initiatives are still ongoing especially in southern African countries (Egoh et al. 2012). Wildlife reserves and conservation policies in Nigeria recognized the livelihoods of people, the role of protected areas in meeting the demand for bush meat and the importance of engaging local communities in protected area development (Idowu et al. 2011).

In Angola, the specific principles for environmental protection, preservation and conservation include, among other things, recognition of the right to environmental education and training; participation in environmental decision making and management; precautionary principles; environmental balance towards achieving sustainable development; and the protection and preservation of natural resources, including national genetic resources. Botswana has a good framework of policy and legislation governing conservation, sustainable use of natural resources and tourism. Namibia has a well-established policy and legal framework for wildlife conservation and protected areas. It has also provided rights to communities over wildlife and tourism through legislation and has a well-developed co-management program established under the legislation. Since the mid-1990s, Zambia has undertaken an extensive review and revision of environmental policy and legislation. This has led to the development of new legislations that largely updates laws in terms of new thinking in conservation and in particular approaches to community involvement in conservation. Zimbabwe has a well-developed set of policies and laws providing for protected areas and wildlife conservation. The policy and legislation explicitly view wildlife as an economic resource which can be used sustainably for the benefit of the nation, private farmers and local communities. The governments of these five countries (Angola, Botswana, Namibia, Zambia and Zimbabwe) are pursuing the establishment of a Trans Frontier Conservation Area (TFCA) called the Kavango-Zambezi TFCA, also known as the KAZA TFCA, with the vision to establish a world-class transfrontier conservation area and tourism destination in the Okavango and Zambezi River basin regions within the context of sustainable development (Jones 2008). Transfrontier parks (TFPs) are defined as 'wildlife conservation areas with common international boundaries managed as a single unit by a joint authority that comprises the representatives of the participating countries' (Sandwith et al. 2001).

A donor-supported transboundary management system of W-Arly-Pendjari (WAP) parks in West Africa exhibited remarkable success in various aspects. The W Regional Park and WAP complex conservation, funded respectively by the European Union and the Global Environment Facility (GEF) projects since 2001, has allowed the development of a technical basis for the transboundary approach and enhanced the effectiveness of protected areas management. It resulted on the harmonization of management strategies and the establishment of the regional patrol and biodiversity survey systems which have strengthened threat reduction. An important tool developed through the cooperative management is the establishment and implementation of a regional coordination system that brings together the three countries- Benin, Burkina Faso and Niger- and all stakeholders involved in WAP protected areas management. A GEF small grant system was also implemented to support rural activities that contribute to biodiversity

conservation and improve riparian communities' livelihoods in the WAP complex. The transboundary management of the complex is an experience which provides excellent lessons for others globally (Amahowe et al. 2013). In east Africa, Cinner et al. (2012) observed that decentralized management was largely donor-driven and only partly transferred power to local stakeholders. However, increased accountability created a degree of democracy in regards to natural resource governance that was not previously present. Additionally, increased local-level adaptive management has emerged in most systems and, to date; such management has helped to change resource user's views from metaphysical to more scientific cause-and-effect attribution of changes to resource conditions in three east African countries- Kenya, Tanzania and Zanzibar.

Conservation can have both positive and negative effects on human well-being by causing changes in ecosystem service flows and reallocation of the distribution of benefits. This can lead to different, sometimes contradictory, outcomes of conservation. For example, forests of Ranomafana National Park area of Madagascar traditionally provide a variety of benefits that contribute considerably to local inhabitants' livelihoods and well-being. Changes in ecosystem service flows due to the strict protection principles alter the provision of many important ecosystem services at the local level, which is likely to affect local livelihoods negatively and increase local vulnerability and inequality. Although conservation might prove beneficial for local people in the long run, its immediate local costs are high. Therefore, integrating local perceptions of ecosystem services into conservation planning becomes important there (Kari and Korhonen-Kurki 2013).

The major underlying source of conflict with local people in Digya National Park of Ghana is the poverty in neighboring communities. This, together with unresolved issues of compensation payment, animal raids on farmlands and exclusion of local communities in the management process, have fuelled illegal activities, mainly hunting and encroachment, leading to several conflict situations. Arrest of culprits and forced evictions by Wildlife Officials had not helped in curtailing illegal activities and conflicts. Therefore, linking wildlife management to community development is necessary to ensure that local economies and livelihoods of fringe communities are sustained while seeking to attain the objectives of wildlife conservation (Ayivor et al. 2013). The poverty alleviation program has become successful at the Golden Gate Highlands National Park in South Africa and it has been inferred from the outcomes of the program that by conceptualizing poverty as a multidimensional state of well-being, this allows for the exploration of a much broader range of potential social, cultural and economic benefits available from protected areas (Pelser et al. 2013). Mburu and Birner (2002) found that receiving benefits from nature conservation is a strong incentive for communities' participation in conservation programs, as evident from Kimana Community Wildlife Sanctuary and Golini-Mwaluganje Community Wildlife Sanctuary of Kenya. Around these two protected areas, landowners are also motivated to participate because their involvement in the co-management arrangements enables them to protect their own property rights, reduce losses from other economic activities (e.g. livestock farming), safeguard human life, and

derive non-cash benefits from infrastructural developments by the state and conservation non-governmental organizations.

The forest areas surrounding Mount Cameroon host some of the highest biodiversity in West Africa including many rare and endemic species of plants and animals. But wildlife populations are in decline, due to an increasing trade in bushmeat, as well as problems of forest encroachment from farmers and large-scale plantation development. In order to check the loss, in collaboration with forest authorities, the Mount Cameroon Project (MCP) has adopted a "participatory biodiversity conservation" approach to wildlife management, which is working with local communities to develop a viable model for participatory and sustainable wildlife management appropriate to local needs in terms of use, capacity and resources (Olsen et al. 2001). One of the strategies the Kenya government has used to address marine resource exploitation on the Kenyan coast has been the establishment of Marine Protected Areas (MPAs). Kenya currently has 4 marine parks managed as fully protected no take areas and six marine reserves where fishing activities are regulated. There is a higher diversity and abundance of key species in MPAs than outside MPAs, indicating the importance of these areas for biodiversity conservation (Muthiga 2006).

In Botswana, national parks and game reserves were created to safeguard and maintain wildlife resources, preserve biodiversity, integrate conservation and development activities, foster ecological education and promote park-based tourism to benefit both resources and people. Botswana has approximately 17 % of its total land mass designated as national parks and game reserves, while 22 % is protected as wildlife management areas (WMAs). The government's commitment to conservation and preservation of the natural and cultural resource base and the promotion of sustainable use of such assets is evident. The protection and preservation of wildlife resources inside and/or on the buffer zones of parks and reserves have largely created the highest population of wildlife in the country. In addition, Botswana has also been ranked high in terms of number and variety of species in Southern Africa (Botswana Tourism Development Program 1999). But still there is the existence of two major policy concerns—a low level of community participation in park activities, and a lack of collaboration and communication between management and residents, as revealed from a study on conservation projects in the Kgalagadi Transfrontier Park (Moswete et al. 2012).

A number of protected areas in many African countries have developed co-management agreements with local communities, and in many areas research activities are undertaken with a significant degree of local participation. In the Bwindi Impenetrable National Park (BINP) in Uganda, for example, revenue-sharing and multiple use programs have helped improve community-park relations and community participation in conservation activities, while enhancing local people's sense of ownership and collective responsibility for the park. In South Africa, creative solutions and opportunities for community co-management and empowerment have emerged from protected areas. The Madikwe Game Reserve, for example, was established with the primary objective of providing an economic engine in an under-developed rural area, and includes a tripartite association

between the park authority, private sector, and communities around the park. In some cases, such emergence has been due to the restoration of land to communities who had historic land rights to the area. The Makuleke community in Limpopo Province, for example, has successfully claimed its land in the Kruger National Park and participated in a Joint Management Board for the area (UNU/IAS 2003).

In Central Africa, in the last decade, policy and legislative reforms within the forestry sector in many countries are beginning to open up opportunities for state-backed, decentralized management. In some countries this legislation has been practically adopted. Some have gone further, setting up community conservation zones on the protected area periphery (Parnell 2006). These zones are areas that either link a number of protected areas in a broader landscape (e.g. the Zakouma National Park ecological corridors in southeast Chad or support community-based tourism activities (e.g. the Lossi Gorilla Sanctuary near Odzala National Park in Congo). In East Africa, governments and supporting donors have encouraged the development of diverse modes of local involvement in natural resource management since the 1990s. In some locales, such as the Amboseli ecosystem in southern Kenya, experiments with CBNRM date back as far as the 1960s and 1970s (Western et al. 2009). In countries such as Ethiopia, Rwanda, Tanzania, and Uganda, the period of 1985–1995 witnessed major changes in political regimes and socioeconomic policies, which fostered widespread policy reform processes heavily backed by foreign donors. In this context of institutional reform and intensive foreign support, the increasingly popular CBNRM narrative was widely promoted and adopted. Following the creation of Amboseli National Park in 1974 in Kenya, the government agreed to a range of benefit-sharing measures, including provision of water services and a proportion of park revenues to six surrounding Maasai group ranches. Tanzania also has a long history of linking protected areas with community benefits- TANAPA's 'good neighborliness' program started in the late 1980s and was designed to give communities a stake in parks, reduce conflicts between park management and local communities, and enhance local benefits (Honey 2008).

Although there are no formal legislative supports for collaborative forest management in Ghana, current collaborative approach towards sustainable forest management in the country involves consultation, needs assessment, investigation, synthesis and consensus building. These are aimed at ensuring equity and the fair distribution of benefits and efficiency in the execution of sustainable forest management prescriptions (Mensah and Amoah 2013). Co-managing the commons within the new governance structures of South Africa has the potential to promote participatory democracy and improve natural resource management. In line with post-1990 democratization processes, public involvement, participation, community-based initiatives and co-management have been promoted as key aspects of natural resource management policies. Power sharing, empowerment, organizational capacity building and improved natural resource management are some of the key principles of co-management within the South African context (Isaacs and Mohamed 2000). Local communities in Liuwa Plain National Park, Zambia

receive several financial and non-financial benefits resulting from the Park partnership. For example, annual jobs increased by 733 % from 12 jobs in 2004 to 100 jobs by 2011 for local people in 'low volume, high value' tourism development. The transfer of benefits for rural development was linked to wildlife conservation; as a result project development by local communities is increasingly supporting Park sustainability (Nyirenda and Nkhata 2013). Fernandez (2010) explored the impact of wildlife conservation policies on the welfare of communities living in Zambian Game Management Areas (GMAs). Households living in prime GMAs enjoy 17 % higher incomes than those living in non-GMA areas. Rodgers et al. (2002) revealed the efficacy of joint management of Karamoja forests by the *Iik* community in northeastern Uganda. Mbile et al. (2005) viewed the management process of Korup National Park, Cameroon as a 'development process' with a considerable improvement in forest protection, community involvement, research, monitoring, ecotourism, and many administrative aspects.

10.2.3 European Region

Generally, plants were well perceived by local residents in the Donana National and Natural Park in southwestern Spain and on an average, they showed the best attitudes towards birds, followed by mammals, reptiles, fish, and invertebrates (Martin-Lopez et al. 2007). Pipinos and Fokiali (2009) revealed the attitudes of the Community of Olympos in Northern Karpathos area of Greece, which is included in the European Ecological Network Natura 2000. Residents showed a high degree of awareness and sensitivity regarding environmental conservation issues in the area, and had a favorable attitude towards the implementation of initiatives in the ecotourism field aimed at their empowerment and at promoting sustainable development in the area. Among many other real and potential benefits, the Kure Mountains National Park in Turkey protects the region's main source of water, harbors major genetic materials and provides attractions for a growing number of international tourists, thereby, assisting livelihoods of the surrounding some 20,000–30,000 inhabitants, many of whom live on a per capita income of around 400 euros a year. Yet the park authorities manage the resources of the protected area with the well-being of the local population in mind (Higgins-Zogib et al. 2010).

Romania's protected areas network currently covers 19 % of the national territory, a significant increase from the 4.1 % protected prior to 1989. The increase occurred over the past 20 years with the creation of 27 National and Natural Parks, and recently of 382 protected areas as part of the pan-European Natura 2000 network. Despite the fivefold increase in protected area, many ecoregions were poorly represented in the new system. Planning for conservation neither involved the local communities nor utilized principles for spatial prioritization. Moreover, almost 80 % of the species of European conservation concern were included in at least one protected area, but plants and invertebrates were underrepresented.

Administrative bodies were generally under-staffed and poorly financed. Overall, Romania shares many conservation concerns with other Eastern and Central European countries. Therefore, a regional approach to conserving biodiversity based on spatial prioritization, rigorous scientific documentation, and social acceptance is needed for the Natura 2000 network to achieve its goals (Ioja et al. 2010). Local people's participation greatly improved people-park collaboration in Triglav National Park, Slovenia (Rodela and Udovo 2008), which is most important for sustainable development.

10.2.4 Oceanian Region

There has been a rapid rise in the number of protected areas in Australia since the 1960 s, and this is continuing as the Commonwealth government aims to increase the size of the Australian National Reserve System (NRS) by 25 % and Australia's network of terrestrial protected areas to 125 million hectares by 2013. The IPA (Co-managed Indigenous Protected Area) program was established in the mid-1990s within the Commonwealth government department responsible for the environment at the time, as a way of providing financial assistance and advice to indigenous people to enable them to look after their traditional land and sea country (Bauman et al. 2013). Generally, the analysis of the various co-management arrangements in Australia shows that land tenure factors have a vital influence on the nature of arrangements negotiated between governments and indigenous communities. Arrangements negotiated in situations where a government will only hand land back to Aboriginal people on condition that it is in turn leased back to the government to be managed as a protected area. For instance, co-management arrangements for Booderee National Park exempt Aboriginal management and use from a range of regulatory provisions, but this is not considered to pose any threats to the successful maintenance of biodiversity. In return, the arrangements also facilitate development interests of the local Aboriginal community (Farrier and Adams 2011). Granek and Brown (2005) noticed efficient biodiversity management and sound community development in Moheli Marine Park of the Comoros Islands in the West Indian Ocean after implementation of co-management approach.

10.2.5 North American Region

The North American Model of Wildlife Conservation is a set of principles that, collectively applied, has led to the form, function, and successes of wildlife conservation and management in the United States and Canada. Some of the basic concerns in the model are: wildlife resources are a public trust, markets for game are eliminated, allocation of wildlife is by law, wildlife can be killed only for a

legitimate purpose, wildlife is considered an international resource, science is the proper tool to discharge wildlife policy, and democracy of hunting is standard (Organ et al. 2012). Fernandez-Gimenez et al. (2008) reported that in the USA, community participation in monitoring is increasing due to government cuts in monitoring programs, the growing need for information on local environmental changes, increasing recognition of the value and importance of including stakeholders in management processes, and a corresponding desire on the part of citizens to participate in management decisions that affect them. In some cases, new approaches reflect attempts by protected area agencies and the private sector to ensure a flow of benefits to neighbors most directly affected by the Park. In Glacier National Park, which has strong historical and contemporary ties to the Blackfeet, Kootenai and Salish tribes, tribal groups and park researchers developed an MOU for research on indigenous resource management practices. Concerns addressed in the agreement included the type of data to be collected by the US National Park Service, the sensitivity of researchers to its meaning for the tribes, and the release of this information into the public domain. For example, information about sacred sites, vision-questing and the use of plants and minerals for ceremonial purposes was considered highly sensitive. Tribal representatives were also wary because researchers had come through in the past, collecting cultural information, and had provided nothing in return, not even research results (UNU/IAS 2003). Based on the case study analysis of community-based forest conservation programs, Kellert et al. (2000) reported a contrasting fact that in Nepal and Kenya, the programs rarely resulted in more equitable distribution of power and economic benefits, reduced conflict, increased consideration of traditional or modern environmental knowledge, protection of biological diversity, or sustainable resource use. By contrast, conservation programs in the North American cases were more successful in every aspect.

Mexico is a priority region for global conservation, ranking among the top five countries of the world for endemism of both vascular plants and vertebrate species. The extent of Mexico's terrestrial reserve network (6.9 % of total land area) is about half of the global average (11.5 %) and well below that of its neighbors Belize (36.6 %), Guatemala (22.1 %), and the United States (24.7 %). Most of Mexico's reserve system is managed mainly for sustainable uses (8.7 million ha) compared with 1.2 million ha managed principally for conservation. However, the country's existing reserve network falls short of adequately protecting its extraordinary species diversity and endemism. Fully 12.7 % of all species of mammals, amphibians, turtles, and birds that occur in Mexico are not protected—marking them as gap species. Moreover, the national reserve network does not cover 32.6 % of the endemic species and 48.5 % of the globally threatened species occurring in Mexico, with 55.5 % of all globally threatened species endemic to Mexico (117 species) not covered in any part of their ranges. Perhaps the most significant challenge facing both conservation and development is the need to support rural livelihoods by adequately assessing and capturing the value of environmental services (Brandon et al. 2005).

10.2.6 Latin American Region

A form of decentralized governance, called Municipal Forest Management has been introduced in forestry sector of six countries in Latin America- Bolivia, Honduras, Guatemala, Nicaragua, Brazil, and Costa Rica, where local people are involved in management process in exchange of the provision of the share from forest incomes (Ferroukhi 2003). The major strategy of the Brazilian government for conserving biodiversity is the creation of protected areas. Relatively few studies have evaluated the effectiveness of reserves based on species richness or extinction patterns. The effectiveness of reserves in the state of Minas Gerais, Brazil, in conserving tapir (*Tapirus terrestris*) was assessed by Eduardo et al. (2012) and it was revealed that few areas were truly effective. Another study conducted by Morcatty et al. (2013) showed that the Quadrilatero Ferrifero Reserve in southeastern Brazil represents a region with a significant richness of medium- and large-sized mammals. Ianni et al. (2010) reported the efficacy of participatory forest planning within *Kolla* aboriginal community of Yungas Biosphere Reservein northwestern Argentina.

10.3 Case Study of Communities' View About the Impact of Co-management on Wildlife Status in Rema-Kalenga Wildlife Sanctuary

10.3.1 The Wildlife Species Records and Status in Rema-Kalenga Wildlife Sanctuary

Through the interviews, transect survey and indirect signs, a total of 63 different wild animals including mammals (19), reptiles (8), amphibians (4), and birds (32) were recorded from the study area, of which the occurrence of 51 species was confirmed by sightings and other evidences (Table 10.1) (Figs. 10.1, 10.2 and 10.3). Of the 63 species recorded, 27 are of high conservation importance globally, categorized as Critically Endangered, Endangered or Vulnerable on the IUCN Red List (IUCN Bangladesh 2000). Among them 14 species are mammals, 5 are birds, 7 are reptiles, and 1 is amphibian. Household interviews suggested that 12 mammals (barking deer, wild boar, fishing cat, all kinds of squirrels, macaques and leaf monkeys), five birds, and four reptiles were reported to be have increased in the surrounding forests after execution of the co-management program in the sanctuary (Table 10.2). On the other hand, five mammals, two birds and one reptile species, which were available a decade ago, are now apparently extinct in the forests of RKWS. Additionally, five mammals and four birds were reportedly disappearing from the area in recent times (Table 10.3).

Table 10.1 Wildlife species confirmed or reported in RKWS, with their status, their occurrence and the type of evidence

Common and local names	Latin names	Status	Presence	Evidence
Mammal species				
Rhesus macaque (Kota banor)	*Macaca mulatta*	VU	Conf.	Sightings
Pig-tailed macaque (Singha banor)	*Macaca leonina*	CR	Conf.	Sightings
Assam macaque (Ashami banor)	*Macaca assamensis*	DD	Conf.	Sightings
Wild boar (Bonno shukor)	*Sus scrofa*	NT	Conf.	Skulls and tusks
Fishing cat (Mecho bagh)	*Felis viverrina*	EN	Rep.	
Barking deer (Maya horin)	*Muntiacus muntjak*	EN	Conf.	Horns
Capped leaf monkey (Mukhpora honuman)	*Trachypithecus pileatus*	EN	Conf.	Sightings
Phayre's leaf monkey (Choshma pora honuman)	*Trachypithecus phayrei*	CR	Conf.	Sightings
Golden jackal (Shial)	*Canis aureus*	VU	Conf.	Hearing sound
Mongoose (Beji)	*Herpestes auropunctatus*	NT	Conf.	Sightings
Black giant squirrel (Kalo Kathbirali)	*Ratufa bicolor*	DD	Conf.	Sightings
Orange bellied squirrel (Lal-pet kathbirali)	*Dremomys lokriah*	DD	Conf.	Sightings
Flying squirrel (Uranta kathbirali)	*Petaurista magnificus*	DD	Conf.	Sightings
Irrawaddy squirrel (Badami kathbirali)	*Callosciurus pygerythrus*	NT	Conf.	Sightings
Porcupine (Shojaru)	*Hystrix indica*	EN	Conf.	Tracks and spines
Jungle cat (Bon biral)	*Felis chaus*	EN	Conf.	Sightings
Bengal slow loris (Lojjaboti banor)	*Nycticebus bengalensis*	CR	Rep.	
Hoolock gibbon (Ulluk)	*Hylobates hoolock*	CR	Conf.	Sightings
Common otter (Ood)	*Lutra lutra*	CR	Rep.	
Bird species				
Spotted dove (Ghughu)	*Streptopelia chinensis*	NT	Conf.	Sightings
Rose-ringed parakeet (Tiya)	*Psittacula krameri*	NT	Conf.	Sightings
Red-breasted parakeet (Lal-buk tiya)	*Psittacula alexandri*	NT	Conf.	Captive in cage as pet
Red-vented bulbul (Bulbuli)	*Pycnonotus cafer*	NT	Conf.	Sightings
Spotted owlet (Khuruley pencha)	*Athene brama*	NT	Conf.	Nests, feathers
Dusky eagle owl (Chai-ronga pencha)	*Bubo coromandus*	EN	Rep.	
Magpie robin (Doyel)	*Copsychus saularis*	NT	Conf.	Sightings
White-rumped Shama (Shyama)	*Copsychus malabaricus*	NT	Conf.	Sightings
Hill myna (Mayna)	*Gracula religiosa*	NT	Conf.	Captive in cage as pet
Jungle fowl (Bon morog)	*Gallus gallus*	NT	Conf.	Sightings

(continued)

Table 10.1 (continued)

Common and local names	Latin names	Status	Presence	Evidence
Oriental pied hornbill (Kaak dhonesh)	*Anthracoceros albirostris*	EN	Conf.	Bills and feathers
Common hoopoe (Hudhud)	*Upupa epops*	NT	Conf.	Sightings
Common myna (Bhat shalik)	*Acridotheres tristis*	NT	Conf.	Sightings
Thick-billed green pigeon (Horikol)	*Treron curvirostra*	NT	Conf.	Sightings
White-breasted water hen (Dahuk)	*Amaurornis phoenicurus*	VU	Conf.	Sightings
Greater packet-tailed drongo (Bhimraj)	*Dicrurus paradiseus*	NT	Conf.	Sightings
Paradise flycatcher (Dudhraj)	*Terpsiphone paradisi*	NT	Conf.	Nests and feathers
Black-headed oriole (Holdey pakhi)	*Oriolus xanthornus*	VU	Conf.	Dried meat, beak, bones and feathers
Woodpecker (Kath-thokra)	*Dendrocopos macei*	NT	Conf.	Sightings
Greater flameback (Aguni kath-thokra)	*Chrysocolaptes lucidus*	EN	Rep.	
Little egret (Shada bok)	*Egretta garzetta*	NT	Conf.	Sightings
Emerald dove (Botkol)	*Chalcophaps indica*	NT	Rep.	
Indian cuckoo (Bou kotha kow)	*Cuculus micropterus*	NT	Conf.	Hearing the whimper
Dusky warbler (Boro tuntuni)	*Phylloscopus fuscatus*	NT	Conf.	Sightings
Sparrow (Chorui)	*Passer domesticus*	NT	Conf.	Sightings
Puff-throated babbler (Bon chorui)	*Pellorneum ruficeps*	NT	Conf.	Sightings
Common kingfisher (Maachranga)	*Alcedo atthis*	NT	Conf.	Sightings
White-throated kingfisher (Shada-buk maachranga)	*Halcyon smyrnensis*	NT	Rep.	
Purple-throated sunbird (Modhukheko)	*Nectarinia sperata*	NT	Conf.	Sightings
Green bee-eater (Shuchora)	*Merops orientalis*	NT	Conf.	Sightings
Asian openbill (Shamuk khaori)	*Anastomus oscitans*	NT	Rep.	
Striated grassbird (Tiktikka)	*Megalurus palustris*	NT	Conf.	Sightings
Reptile species				
Common bush snake (Darash shaap)	*Ptyas mucosus*	VU	Rep.	
Monitor lizard (Guishap)	*Varanus bengalensis*	VU	Conf.	Sightings
Indian pangolin (Bonrui)	*Manis crassicudata*	CR	Conf.	Skin
Tokay gecko (Tokhkhok)	*Gekko gecko*	VU	Rep.	
Spectacled cobra (Gokhra)	*Naja naja*	VU	Rep.	

(continued)

Table 10.1 (continued)

Common and local names	Latin names	Status	Presence	Evidence
White-lipped pit viper (Shabuj bora)	*Trimeresurus albolabris*	EN	Rep.	
Checkered keelback (Dhora shaap)	*Xenochrophis piscator*	NT	Conf.	Sightings
Common vine snake (Laudoga shaap)	*Ahaetulla nasuta*	VU	Conf.	Sightings
Amphibian species				
Common toad (Kuno beng)	Bufo melanostictus	NT	Conf.	Sightings
Bull frog (Bhawa beng)	Hoplobatrachus tigerinus	NT	Conf.	Sightings
Taipeh frog (Gachcha beng)	Rana taipehensis	EN	Conf.	Sightings
Skipper frog (Lafainna beng)	Euphlyctis cyanophlyctis	NT	Conf.	Sightings

NT near threatened, *EN* endangered, *CR* critically endangered, *VU* vulnerable, *DD* data deficient, *Conf.* confirmed, *Rep.* reported

Fig. 10.1 Phayre's leaf monkey (*Trachypithecus phayrei*) in Rema-Kalenga WS

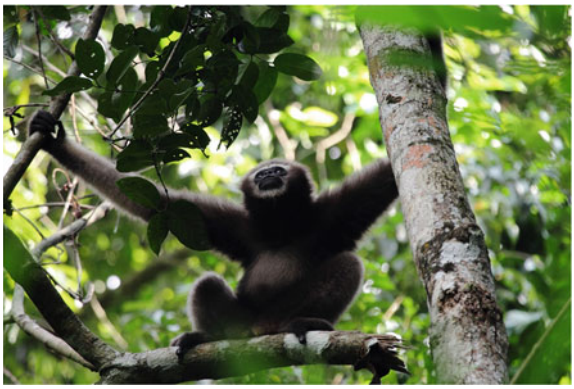

Fig. 10.2 Hoolock gibbon (*Hylobates hoolock*) is frequently seen in Rema-Kalenga WS

Fig. 10.3 Number of red jungle fowl (*Gallus gallus*) increased after the co-management program in Rema-Kalenga WS

Table 10.2 Wildlife that increased after the co-management project in Rema-Kalenga Wildlife Sanctuary

Barking deer (Maya horin)	*Muntiacus muntjak*
All kinds of squirrels (Kath-birali)	*Callosciurus pygerythrus, Dremomys lokriah, Petaurista magnificus, and Ratufa bicolor*
All kinds of macaques (Banor)	*Macaca Mulatta, M. leonine, and M. assamensis*
Both kinds of leaf monkeys (Honuman)	*Trachypithecus pileatus and T. phayrei*
Snakes (Darash, gokhra, laudoga shaap)	*Ptyas mucosus, Naja naja, Ahaetulla nasuta*
Birds (Bon morog, ghughu, botkol, shalik, bhimraj)	*Gallus gallus, Streptopelia chinensis, Chalcophaps indica, Acridotheres tristis, Dicrurus paradiseus*
Wild boar (Bonno shukor)	*Sus scrofa*
Fishing cat (Mecho bagh)	*Felis viverrina*
Monitor lizard (Guishap)	*Varanus bengalensis*

10.3.2 Reasons for Wildlife Disappearance

Households in all zonal locations were asked about the possible reasons for the disappearance of wildlife in Rema-Kalenga Wildlife Sanctuary, in response to which they reported eight different reasons, and the differences were significant among households according to village positions (Table 10.4). 'Habitat destruction' was mentioned by most of the respondents (97 %), followed by 'reduction of fruit trees in forests' (94 %) and 'forest fire in dry season' (90 %). 'Hunting for bushmeat' and 'capturing wildlife and their babies for selling live' were reported by considerable portions of respondents- 86 % and 85 %, respectively. The other reasons were 'planting exotic tree species in the forest' (83 %), 'attack by predator animals' (66 %) and 'unawareness of the community members' (64 %).

Table 10.3 List of wildlife species already disappeared in last 10 years, and disappearing currently from Rema-Kalenga Wildlife Sanctuary

Wildlife already disappeared	
Leopard (Cheeta bagh)	*Panthera pardus*
Sambar (Moisha horin)	*Cervus unicolor*
Asiatic black bear (Bhalluk)	*Ursus thibetanus*
Asiatic elephant (Hati)	*Elephas maximus*
Wild cow (Bongoru)	*Bos frontalis*
White-rumped vulture (Shokun)	*Gyps bengalensis*
Black kite (Bhubon chil)	*Milvus migrans*
Rock python (Ojogor)	*Python molurus*
Wildlife currently disappearing	
Golden jackal (Shial)	*Canis aureus*
Bengal slow loris (Lojjaboti banor)	*Nycticebus bengalensis*
Hoolock gibbon (Ulluk)	*Hylobates hoolock*
Porcupine (Shojaru)	*Hystrix indica*
Indian pangolin (Bonrui)	*Manis crassicudata*
Red-breasted parakeet (Tiya)	*Psittacula alexandri*
Hill Myna (Myna pakhi)	*Gracula religiosa*
Oriental pied hornbill (Kaak dhonesh)	*Anthracoceros albirostris*
Black-headed oriole (Holdey pakhi)	*Oriolus xanthornus*

10.3.3 Community's Outlook on the Necessity of Conserving Wildlife

All the respondents were found to be in the favor of conserving wildlife in the sanctuary. Eleven reasons for conserving wildlife were reported in the study area with significant differences among households based on the spatial distribution (Table 10.5). All addressed the various intangible benefits generated by wildlife species that ultimately contribute to the well-being of mankind. The outlook 'wildlife ensures a better environment' was expressed by most of the respondents (93 %), followed by the outlooks 'wildlife is for the betterment of future generations' (91 %), 'wildlife generates eco-tourism' (88 %), and 'wildlife increases the beauty of nature' (88 %). The other community outlooks regarding the necessity of conserving wildlife concerned maintaining biodiversity and ecological balance, aiding in scientific research, enhancing plant regeneration, nourishing the human mind, chasing illicit fellers, and assisting farmers in lessening the crop damage.

10.4 Discussion

The increasing appreciation of the interdependence of diverse environments and local communities and the roles they play in conserving biological diversity has inspired collaborative approaches of protected area management around the world

Table 10.4 Reasons for disappearance of wildlife in Rema-Kalenga Wildlife Sanctuary

Reasons	All villages	Village positions			Statistics		
		Inside/ core zone (n = 30)	Adjacent/ buffer zone (n = 148)	Outside/ outer zone (n = 124)	χ^2	*P*	Cramer's V
Planting exotic tree species	82.78	16.67	87.84	92.74	127.93	0.000	0.256
Reduction of fruit trees in forests	94.04	93.33	94.59	93.55	92.87	0.000	0.241
Hunting	85.76	13.33	91.22	96.77	187.82	0.000	0.223
Habitat destruction (for agriculture, lemon garden, agroforestry)	97.35	96.67	97.29	97.58	90.68	0.000	0.233
Unawareness of the local community	64.24	53.33	64.19	66.94	98.37	0.000	0.201
Attack by the predator animals	66.23	96.67	71.62	52.42	63.89	0.000	0.212
Forest fire in dry season	89.74	83.33	91.89	88.71	93.84	0.000	0.244
Capturing wildlife and their babies for sale in market illegally	85.43	86.67	97.97	70.16	78.66	0.000	0.262

(Ibarra et al. 2011). Community-based forest management has been implemented in more than 60 countries with the main objective of promoting sustainable development and biodiversity conservation (Alemagi 2010). However, in many cases, the establishment of protected areas has failed to achieve the desired outcomes due to a pure ecological focus and a poor recognition of local peoples' rights and practices (Ormsby and Kaplin 2005). Protected areas in developing countries are increasingly expected to move beyond biodiversity protection so as also to contribute to poverty reduction and the economic development of their surrounding communities (Pelser et al. 2013). Although ecosystem services are important in supporting livelihoods both in developed and developing countries, humans dependence on provisioning services is mostly acknowledged in developing countries, rather than the developed ones (Egoh et al. 2012). In such context, achieving the desired efficacy often appears as a stern challenge in countries like Bangladesh with a dense population (1,475 people/km^2), who are continuously exerting tremendous pressure on the scanty forestlands (17.08 % of the total land). An imbalanced demand-supply cycle exists in the country, displaying a gap between production and demand of forest products (Rahman 2012) that accelerates the occurrence of over-exploitation of forest resources, resulting in the disappearance of certain local biodiversity (Chowdhury et al. 2014). In such a precarious situation, the government has initiated a co-management approach in protected areas, involving local communities in all possible stages of the management process. The program resulted in the manifestation of success in terms of forest conservation and community development, as evident from the findings of studies described in this book.

Table 10.5 Local community's view on the necessity of conserving wildlife in and around Rema-Kalenga Wildlife Sanctuary

Community's opinions	All villages	Village positions			Statistics		
		Inside/ core zone (n = 30)	Adjacent/ buffer zone (n = 148)	Outside/ outer zone (n = 124)	χ^2	*P*	Cramer's V
To maintain biodiversity	80.13	6.67	85.81	91.13	194.36	0.000	0.319
For research purpose	78.14	30.00	80.41	87.09	210.25	0.000	0.308
To increase the beauty of the forest/beautification of nature	88.08	53.33	94.59	88.71	223.41	0.000	0.332
For tourism	88.41	93.33	89.86	83.87	291.00	0.000	0.293
For the betterment of future generations (they shouldn't be deprived of the beauty of wildlife)	91.39	90.00	97.97	93.55	246.95	0.000	0.331
I feel better hearing the sound of wildlife (chirping of birds and sounds of animals)	65.23	73.33	70.95	56.45	212.99	0.000	0.311
Wildlife enhances plant regeneration	80.79	80.00	85.81	75.00	137.98	0.000	0.273
For a better environment	93.05	100.00	97.97	85.48	255.12	0.000	0.161
Capped leaf monkey helps protecting crops by chasing monkeys	87.09	100.00	94.59	75.00	206.17	0.000	0.362
Birds eat insects; in that way, they indirectly helps protecting agri-crops	87.75	93.33	94.59	78.23	198.46	0.000	0.360
Ferocious wildlife helps preventing illicit felling by keeping away the illegal cutters	87.42	100.00	97.97	71.77	253.46	0.000	0.308

Shahabuddin and Rao (2010) observed a globally significant improvement in terms of conservation effectiveness in community-conserved areas over open-access areas. Such an incidence was also evident from the other corners of the world. The community-conserved small Tibetan village sacred forests in northwest Yunnan in China protect relatively intact native vegetation and support distinct bird communities and higher bird diversity compared to the surrounding landscapes (Brandt et al. 2013). As an impact of village-level conservation efforts in these forests, the villagers reported about more wildlife such as deer, rabbits, and squirrels (Allendorf et al. 2014). Nelson et al. (2013) reported the dramatic recovery of wildlife in the communal conservancies in Namibia; for example, the lion population in the Kunene region in northwest Namibia, where many

communal conservancies are located, grew from only a few in 1999 to 120 by 2009. The biophysical and socio-economic parameters such as coral reef health, socio-economic welfare and stakeholders' participation were significantly improved in Mombasa Marine National Park, Kenya with the cordial support of the local communities (Muthiga 2006). Therefore, experiencing the consequences, local peoples' support and involvement for protected area management have been viewed as important elements of enhanced conservation in recent years, especially in developing countries (Nagothu 2003; Wells and McShane 2004).

On the contrary, there are arguments describing that protected areas are not the panacea of all conservation-related problems. By examining data from 163 forests in 13 countries, Hayes (2006) found no statistically significant differences in forest conditions between legally protected forests and forests governed by users who establish and recognize forest rules. Furthermore, higher levels of vegetation density and significantly more forest rules exist in areas not legally protected. The dearth of rules in protected areas suggests that parks may not be the optimal governance structure for promoting local conservation (Hayes 2006). By compiling over 270 wildlife counts of Kenya's wildlife populations conducted over the last 30 years, Western et al. (2009) compared the trends in national parks and reserves with adjacent ecosystems and country-wide trends in Kenya. The study revealed that national park and reserve populations have declined sharply over the last 30 years, at a rate similar to non-protected areas and country-wide trends. The losses vary among parks; the largest parks- Tsavo East, Tsavo West, and Meru-account for a disproportionate share of the losses due to habitat change and the difficulty of protecting large remote parks. The losses point to the need to quantify the performance of conservation policies and strengthen integrated landscape practices that combine parks with private and community-based measures. Yahnke et al. (1998) focused on inventories in Paraguay, and verified that the parks did not fulfill the function of encompassing certain target mammal species for which they were created. Timko and Satterfield (2008) examined the efficacy of protected areas in Canada and South Africa in addressing social equity, including property and human rights and relationship between indigenous people and park managers. They found all the six national parks were achieving or moving towards equity. Particularly, protected areas with more comprehensive co-management and support from neighboring indigenous groups demonstrated higher equity scores across a variety of indicators, whereas those with lower levels of co-management do less well. Therefore, it can be inferred that co-management agreements among indigenous people and other local communities, state agencies, and other stakeholders offer substantial promise as a way of dealing with natural resource use, conflicts in utilization, and biodiversity conservation in a participatory and equitable manner (Castro and Nielsen 2001).

The case study conducted on the local communities living in and around Rema-Kalenga Wildlife Sanctuary, revealed an increase in 21 wildlife species including mammals, reptiles, and birds in the forest of the sanctuary since the beginning of the new management program. These include the barking deer, wild boar, fishing cat, monitor lizard, both kinds of leaf monkeys, all three species of

macaques, all the four species of squirrels, three species of snakes, and five species of birds. Among them, the barking deer, fishing cat, and capped leaf monkey are listed as endangered on the IUCN Red List; the pig-tailed macaque and Phayre's leaf monkey as critically endangered; the rhesus macaque, monitor lizard, and all the snakes as vulnerable; and the Irrawaddy squirrel and all the birds as near threatened (IUCN 2000). This is quite an impressive outcome reflecting the significance of co-management in conserving globally important wildlife species in their local habitats.

In contrast, the study discovered incidences of disappearance in eight different species from the surrounding forests of the sanctuary in the recent past. All the respondents strongly agreed that the numbers in nine other species are gradually reducing with a possibility of extinction in the future, if precautionary measures are not taken immediately. This has been attributed to eight different causes, mostly anthropogenic in nature. Habitat destruction in the forms of clearing forest for the purposes of agriculture, horticulture and agroforestry practices; collecting fuel wood for household consumption; and harvesting non-timber forest products (NTFPs) were reported as the most precarious among the causes. Since the local communities living in and around the sanctuary are economically insolvent, having insufficient or no agricultural land, they have to depend on the resources of nearby forests for almost all of their everyday livelihoods (Chowdhury et al. 2011, 2013, 2014). Moreover, the massive gap between the demand and permissible supply provides opportunities to the local people to overharvest forest resources and extract fuel wood and timbers illegally (Rahman 2012; Sarker and Roskaft 2013). Small (2011) blamed the agricultural use of forest land as the most common cause of habitat decline, which, along with overharvesting, is exacerbating species loss worldwide. In Kenya, loss of wildlife habitat driven by anthropogenic factors is considered one of the main causes of declining species number and abundance, where 51 mammal species out of a total of 376, are reported to be threatened with extinction (Watson et al. 2010). Kidwari (2013) revealed the negative effects of anthropogenic factors such as human trails, wood cutting, tree lopping, and cattle grazing on the encounter rate of five Galliformes species in Sariska Tiger Reserve, India. In our study area, the reduction in fruit trees in the forest was regarded as a potential cause of the reduction in wildlife, particularly those other than carnivores. This indicates a serious issue regarding the shortage of foods, the basic requirement of any living being. The respondents mentioned a tree species-*Dillenia pentagyna*, flowers and fruits of which once served as foods for many wildlife species, particularly the primates and birds. But the tree almost disappeared recently from the forest due to the overharvesting of its bark for its medicinal properties and thus having commercial value locally (Chowdhury and Koike 2010). Therefore, it can be inferred that there were two interlinked consequences: because of the food shortage, the wildlife species either became extinct or migrated to other regions resulting in their reduction in number in the sanctuary, and because of the absence of the faunal agents, the rate of natural regeneration of plant species was hampered. This assumption is consistent with the opinions of Nasi et al. (2011): in nature, some species have been characterized as ecosystem

engineers and ecological keystone species that affect plant distribution and structure ecosystems through seed dispersal and predation, grazing, browsing, rooting and other mechanisms, and their loss would generate the "empty forest syndrome" and ecological imbalance. Forest fire in dry season was another significant cause of wildlife loss in the study area, supplementing habitat destruction. It was reported to be carried out mainly to make the forestland suitable for agriculture by the local people. Hunting and poaching were also reported as the important problem for wildlife sustenance in the study area. Throughout the world, although bushmeat is an important part of many local diets, hunting wild animals for it is often in conflict with conservation objectives (van Vliet and Nasi 2008). As a long-term consequence, hunting can affect the behavior and abundance of exploited species, which can also alter the population structure of the victim species (Velho et al. 2012). Fa and Peres (2001) characterized it as an even greater threat to biodiversity. The labelling seems to be right for many regions. For example, the practice of wildlife hunting in northeast India is seen as one of the significant contributors towards wildlife population decline and the possible extinction of some species (Aiyadurai 2011). Hunting is the major cause of the reported 50 % decline in apes in Gabon within two decades (Walsh et al. 2003), while hunted populations of black colobus (*Colobus satanas*) in the Congo Basin, spider monkeys (*Ateles* sp.) and woolly monkeys (*Lagothrix* sp.) in the Amazon basin have declined precipitously (Kumpel et al. 2010). Kiringe and Okello (2007) revealed bushmeat trade and poaching for trophies as the two most relatively severe threat factors in east African protected areas, while Corlett (2007) commented that hunting practices especially threaten the biodiversity of the southeast Asian region. Hunting for bushmeat is not apparently widespread in Bangladesh; rather, it is carried out on a very limited scale, particularly by the tribal communities (Chowdhury et al. 2007). However, attention is needed from the management authority because poaching wildlife for trading body parts in clandestine markets has been reported to some extent in Bangladesh (Chowdhury et al. 2014).

Although irrespective of spatial variation of the communities, all the respondents strongly agreed that there is a need to conserve wildlife; several interesting commonalities and differences were revealed in their attitudes on the necessity of conserving wildlife. Most local residents had an understanding about wildlife conservation for a better environment. Most of their remaining ideas, for example, the intangible functions of wildlife such as increasing aesthetic value, pacifying the human mind with natural sounds and chirps, maintaining balance in biodiversity, enhancing plant regeneration, and serving ecotourism services, supplemented this opinion. Despite their little mention of conflict with some wildlife arising from crop raiding, the respondents described the matter in a positive way. According to them, mainly the macaques do harm to agricultural crops, but alternatively, the capped leaf monkey helps in protecting crops by chasing macaques. Similarly, they mentioned the birds' helpful action in increasing crop production by feeding on harmful insects. Moreover, they think that the presence of ferocious mammals could play a role in preventing illegal trespass and thus illicit felling by keeping the outside wood cutters away. It is anticipated that all

these positive attitudes provide great incentive to educate and encourage local people's participation in biodiversity conservation and forest protection efforts. But at the same time, it is of interest how local people's attitudes have been shaped in a more positive way, especially when they have a lower literacy rate. Sometimes, it is commonly seen among the communities in economically developed societies as in the surrounding areas of the Bavarian Forest National Park of Germany, where the majority of the landowners have shown positive attitudes toward the presence of red deer beyond the boundaries of the park, even with the expected threat of severe browsing and bark stripping damage to an extent that could not be compensated either financially or ecologically (Gerner et al. 2012). Shelley et al. (2011) commented that human attitudes, beliefs, and cultural credos favor or undermine the existence of many wild animals throughout the world. They reported the significantly positive attitudes of the Chippewa Indian tribe toward the gray wolf (*Canis lupus*). They are more supportive of protective policy and less supportive of a public wolf harvest in Wisconsin's wolf range in the USA. Williams et al. (2011) revealed the positive attitudes of more than half of the local residents in Northeast Texas toward the recovery and reintroduction of the Louisiana Black Bear (*Ursus americanus luteolus*), an endangered species native to the region. In our study area, the positive attitudes of the local people were assumed to be the consequential effects of the benefits in the form of training and accompanying supports regarding AIG activities provided by the co-management project. Our assumption was corroborated by the findings of a study conducted among the same communities by Chowdhury et al. (see Chap. 7 of this book). They found about 82 % of the local residents received training from the Forest Department in 12 different AIG activities, by implementing which, their average annual income was increased by almost 68 %. Mukul et al. (2012) also revealed the local residents' understanding of the ecological implications of NTFP harvesting, sustainability, and possible management and monitoring regimes in the communities surrounding Satchari National Park, Bangladesh. Xu et al. (2006) unveiled appropriate facts on the topic of local people's attitudes toward protected areas as being dependent on their perceived cost and benefits from the areas themselves and the development programs based on them. It was manifested in the study that, whatever the reason behind it; the local communities were aware of the importance of wildlife and its conservation in its natural habitats. As Nelson et al. (2014) stated, the awareness, attitudes and opinions of the local people and other relevant stakeholders are considered to be the major keys to the success of any collaborative resources management initiatives; these need to be explored and analyzed to identify the problems and recognize potential solutions for developing appropriate strategies. Local people, especially those living in and around protected areas, have long-standing relationships with and practical understanding of these areas. Therefore, instead of assuming legal designation of protected areas the only policy tool for effective conservation, efforts should be extended to involve the local communities in decision-making processes if protected area managers seek to promote forest conservation productively.

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Chapter 11
Potential Threats, Their Patterns and Extent to the Protected Areas of Bangladesh: A 'Red Flag' to Biodiversity Conservation Efforts

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Abstract Multi-dimensional threat factors occur in the protected areas of Bangladesh, making the country's biodiversity conservation program fragile. Understanding the type, pattern, and extent of the threats is a crucial issue in controlling their magnitude. This study attempted to assess the relative severity of threats to protected areas and the degree of susceptibility of protected areas to those threats. 102 officials from the 34 protected areas were interviewed electronically. Ten potential threats were identified. The most severe threats were fund shortage and policy level disorganization, illegal tree cutting, unsustainable forest resource extraction, forestland encroachment, and wildlife poaching and smuggling. The findings indicate that protected areas throughout the entire ecosystem are at risk, and that threats vary geographically. One-third of the protected areas were susceptible to 80 % of the threats. Protected areas in the tropical moist evergreen and semi-evergreen forests of hilly regions were highly subject to illegal wood cutting; while those in tropical moist deciduous forests of plain land area were prone to encroachment for settlement and agriculture, and those in mangrove forests of littoral zones were extremely vulnerable to wildlife poaching. Developing rapid strategies to mitigate for these threats, with multi-sectorial coordination and stakeholder involvement, is essential to managing protected areas properly and to reduce the continuing loss of biodiversity in Bangladesh.

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M. S. H. Chowdhury (ed.), *Forest Conservation in Protected Areas of Bangladesh*, World Forests 20, DOI: 10.1007/978-3-319-08147-2_11,

11.1 Introduction

These days, biodiversity loss is considered a comprehensive global environmental challenge (Brashares et al. 2004; Cardinale et al. 2012; Craigie et al. 2010; Cuthbert 2010; Krause and Zambonino 2013). Habitat loss and over-exploitation of wildlife, and other forest resources, are universally acknowledged as the leading causes of biodiversity loss (Baldus 2008; Brooks et al. 2002). In the tropical regions, deforestation and forest fragmentation, together with land use intensification, are viewed as the primary drivers for biodiversity loss (Leuschner et al. 2013). Human population growth, particularly in developing countries, has profound direct and indirect effects on consumption patterns of land and wild resources, and is a constant contributing factor to the damaging of biological diversity (Kideghesho 2009; Michel 2008). The role played by humans, both in Bangladesh and around the globe, in the extinction or reduction of many species of plants and animals is commonly recognized (Grignolio et al. 2011). In regards to continued degradation, the fight against biodiversity loss has become a priority for both governments and nature conservation organizations worldwide (Lambooy and Levashova 2011). Various approaches to tackle the causes of biodiversity loss have emerged in the past few decades (Vatn et al. 2011). The declaration of forests as protected areas is regarded as an important strategy in biodiversity and watershed conservation (Hales 1989; Kramer et al. 1997; Newton 2011; Sekhar 2003; Shahabuddin and Rao 2010; Walpole et al. 2001). The practice of naming protected areas represents a globally prevalent approach to reduce biodiversity loss, with a spectrum ranging from: exclusive areas without people that are strictly protected by the state, to areas subject to intensive use managed entirely by local communities (Shahabuddin and Rao 2010). The number of global protected areas continues to increase, with nearly 133,000 sites now designated with a protected status (Butchart et al. 2010; Grignolio et al. 2011), representing $\sim$ 13 % of the total terrestrial area and $\sim$ 5.5 % of the total marine area under national jurisdiction being designated as such (Jones 2013). At the 10th Conference of the Parties to the Convention on Biological Diversity, it was agreed that 17 % of the global terrestrial and inland water area, and 10 % of the global coastal and marine area should be effectively conserved through protected area designations by 2020 (CBD 2010). But results have shown that legal designation of an area as protected does not always ensure effective management and efficient conservation activities (Chowdhury and Koike 2010a; Ervin 2011). This can only be guaranteed if measures are taken to reduce and/or discard the various obstacles already exist in protected areas, hindering the execution of the conservation principles effectively (Mannigel 2008).

Conservation authorities and the government have a responsibility to conserve and protect any country's ecosystems and associated biodiversity as both a national service and contribution to the global biodiversity conservation (Okello et al. 2001). Moreover, because most states are a party to the Convention on Biological Diversity (CBD) and the Convention on International Trade in

Endangered Species of Wild Fauna and Flora (CITES), they have been continuing their efforts in biodiversity conservation (Lambooy and Levashova 2011). Bangladesh is a signatory party of the Convention on Biological Diversity (CBD) and the Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES), and thereby, has been continuing the efforts in biodiversity conservation (MoEF 2014). Declaration of forests, or parts of forests, as protected areas in Bangladesh dates back to 1960s under the provision of the Forest Act 1927 that was, further fortified in the comprehensive legislative instrument of the Bangladesh Wildlife (Preservation) Order 1973 (Chowdhury et al. 2009). The mission got its momentum with multifarious regulatory provisions of biodiversity conservation articulated in the Wildlife (Preservation and Protection) Act 2012 in which, adopting the approach of co-management has been emphasized (BFD 2013). Although it's a stern challenge to keep the forest aside as 'protected' in such a densely populated country as Bangladesh where around 85 % rural people are diversely dependent on forest resources, the government is showing it's keenness to biodiversity conservation (Balasinorwala et al. 2008; Chape et al. 2008). Today there are 34 protected areas in Bangladesh encompassing all forest and ecosystem types throughout the country. Among those, 17 are national parks and 17 are wildlife sanctuaries (BFD 2013). In addition, there are a number of eco-parks and safari parks, which are extremely small by comparison to the scheduled protected areas, and are designed to serve 'nature recreation' needs rather than large scale conservation needs (Chowdhury et al. 2009). Historically, protected areas in Bangladesh have been managed using approaches that exclude local people, whose interests have been viewed as incompatible with the conservation of these areas (Sarker and Roskaft 2011). As noted by Bengtsson et al. (2003), protected areas are subject to both natural and human-induced disturbances at various scales, but it is the intensification of disturbance arising from human activity that is their principal threat (Chape et al. 2005) and can be well expressed by the term 'anthropogenic threats'. Mannigel (2008) argued that if this human-induced threat could be minimized, by active involvement of those liable people in the management process, the protected area system for biodiversity conservation would become effective. Kainer et al. (2009) also considered the involvement of local communities in conservation projects as a key issue for the success of programs aiming to promote biodiversity protection. People's participation in forestry activities started formally in Bangladesh in the 1980s with the initiation of a forestry extension programme on public forestlands (Rana et al. 2007). As an alternative to traditional forest management, people-oriented forestry has been introduced there in order to increase the country's forest cover (Muhammed et al. 2008). And community-based forest management using the co-management approach was initiated in Bangladesh's protected areas in 2004 with the involvement of local level stakeholders (Chowdhury et al. 2011). Sarker and Roskaft (2011) commented that this approach has grown out of attempts to find new solutions for the failure of the so-called 'fences and fines' approach to conservation in the country. Rashid et al. (2013) observed the slow but visible changes of this co-management interventions in protected areas of Bangladesh where

decentralized, site-specific and community based activities are gradually, and to varying degrees, taking root in place of centralized, classical, custodial approaches to natural resource management. Chowdhury et al. (2009) also reported the gradual proceeding of the Bangladesh's protected area system towards success for biodiversity conservation through the involvement of local communities in management activities. However, despite the demonstration of quite a few positive impacts of protected area based co-management program both on the forest conservation and community development, there are still a number of bottlenecks in the system (Chowdhury et al. 2011). The bottlenecks in the implementation of protected area system often pose serious threats to conservation efforts of the respective country (Holmern 2003). Ervin (2011) conceded with such perception stating that despite the considerable growth of protected areas over the last 130 years throughout the world, there are many troubling trends. Understanding the type, pattern, and extent of the threats to and troubles of protected areas is, therefore, a crucial factor in controlling their magnitude in order to heighten the performance of biodiversity conservation programs. The parties of CBD adopted a definition for protected area threat in 2004 in its Program of Work on Protected Areas (PoWPA), which is expressed as "any human activity or related process that has a negative impact on key biodiversity features, ecological processes or cultural assets within a protected area" (CBD 2004). Since due to the lack of sufficient funds, protected areas cannot be managed effectively and therefore, viewed as a potential constraint to materialize the conservation plans and impediment of other management issues, especially in developing countries like Bangladesh (Choudhury and Hossain 2011), it has been included in the present study along with the more traditionally defined direct and indirect threats. Taking all these issues into consideration, this chapter reports the findings of a comprehensive assessment on threats to the biodiversity conservation initiatives in the existing protected areas of Bangladesh.

11.2 Threats in the Protected Areas

Protected areas of Bangladesh are prone to a range of threats (Table 11.1). The threat "shortage of funds" scored the highest among the ten given threats. The threats "shortage of funds" and "lack of policy level integration" were reported in all the 34 protected areas, while "illegal cutting of trees" was reported in 30 sites (88 % of the country's total protected areas) followed by "unsustainable and non-scientific harvesting of forest products" (28 protected areas, 82 % of the total).

Fourteen protected areas, constituting over 40 % of the country's total, were susceptible to eight or more threats. Seven (21 %) protected areas reported seven threats, five areas (15 %) reported six threats, five areas (15 %) reported five threats, and three areas (9 %) reported 4 threats. The protected area ranks are shown in Table 11.2, based on the susceptibility index (PASI).

When the relative threatened index (PARTI) is taken into consideration, it was revealed that 10 protected areas (29.41 % of total) had an index of 0.6 and above,

Table 11.1 Threat that operate against biodiversity in the protected areas of Bangladesh

Threat identified by PA managers	No. and relative frequency of PAs where threat factors exist	Mean score of the threat factors	Relative severity index of the threat factors
Shortage of funds impairing the materialization of the long-term visions and commitments of PA-based biodiversity conservation	34 (100 %)	4.70 ± 0.19	0.92
Illegal cutting of trees and black market trade of timbers resulting in denudation of forests	30 (88 %)	4.10 ± 0.12	0.87
Unsustainable and non-scientific harvesting of forest resources by local communities living in and around PAs	28 (82 %)	3.84 ± 0.20	0.80
Current expansion of real estate business inducing land grabbers to encroach forestlands	10 (29 %)	3.74 ± 0.17	0.78
Poaching of selected mammals by smugglers resulting in their decline in natural habitat	21 (62 %)	3.60 ± 0.24	0.72
Non-cooperation from local communities for implementation of PA activities that arises from human-wildlife conflicts	18 (53 %)	3.20 ± 0.20	0.65
Apathetic mindset against eco-tourism that appears hostile to the biodiversity and its habitat	17 (50 %)	2.96 ± 0.18	0.63
Unnecessary delay in legal procedures regarding land litigation that encourages the encroachers	23 (68 %)	2.80 ± 0.21	0.56
Lack of integration at policy level that hampers the implementation of any new project in Forestry sector	34 (100 %)	2.46 ± 0.14	0.42
Corruption of the FD authorities resulting in the collaborative deterioration of forests with the ruffians	15 (44 %)	1.84 ± 0.22	0.39
Mean		3.32 ± 0.12	0.64 ± 0.09

and eight (24 % of total) had an index of 0.7 and above. Four protected areas (12 % of total) had the highest index of 0.8 and above, while only one (3 %) had the lowest index (0.38) (Table 11.2). The protected areas are also ranked based on the relative threatened index (PARTI) and shown in Table 11.2.

Among the 16 tropical moist evergreen forest in the hilly regions, 14 were found most vulnerable (having both the PASI and PARTI of 0.60 to >0.80). In this category, the most threatened protected areas are Teknaf WS, Chunati WS, and

Table 11.2 Relative threat index, geographical location, forest type, and area of the protected areas of Bangladesh

Protected Areas		No. of threats exist	PASI (rank)	PARTI (rank)	Geography	Forest type	Area (ha.)
National Parks (NP)	Bhawal NP	8	0.80 (2)	0.74 (4)	Hilly	TMDF	5022.00
	Modhupur NP	8	0.80 (2)	0.78 (3)	Plain	TMDF	8436.00
	Ramsagar NP	6	0.60 (4)	0.38 (18)	Plain	TMDF	27.75
	Himchari NP	6	0.60 (4)	0.54 (13)	Hilly	TMEF	1729.00
	Lawachara NP	8	0.80 (2)	0.60 (10)	Hilly	TMEF	1250.00
	Kaptai NP	8	0.80 (2)	0.80 (2)	Hilly	TMEF	5464.00
	Nijhum Dweep NP	5	0.50 (5)	0.74 (4)	Littoral	MNGF	16352.23
	Medha-Kachhapia NP	6	0.60 (4)	0.72 (5)	Hilly	TMEF	395.92
	Satchari NP	7	0.70 (3)	0.68 (6)	Hilly	TMEF	242.91
	Khadim Nagar NP	7	0.70 (3)	0.64 (8)	Hilly	TMEF	678.80
	Baraiyadhala NP	5	0.50 (5)	0.62 (9)	Hilly	TMEF	2933.61
	Kuakata NP	5	0.50 (5)	0.52 (14)	Littoral	MNGF	1613.00
	Nobabgonj NP	4	0.40 (6)	0.42 (16)	Plain	TMDF	517.61
	Shingra NP	4	0.40 (6)	0.48 (15)	Plain	TMDF	305.69
	Kadigarh NP	4	0.40 (6)	0.40 (17)	Plain	TMDF	344.13
	Altadighi NP	4	0.40 (6)	0.52 (14)	Plain	TMDF	264.12
	Birgonj NP	4	0.40 (6)	0.55 (12)	Plain	TMDF	168.56

(continued)

Table 11.2 (continued)

Protected Areas		No. of threats exist	PASI (rank)	PARTI (rank)	Geography	Forest type	Area (ha.)
Wildlife Sanctuary (WS)	Rema-Kalenga WS	9	0.90 (1)	0.66 (7)	Hilly	TMEF	1795.54
	Char Kukri Mukri WS	6	0.60 (4)	0.58 (11)	Littoral	MNGF	40.00
	Sundarban East WS	7	0.70 (3)	0.78 (3)	Littoral	MNGF	31226.94
	Sundarban West WS	7	0.70 (3)	0.80 (2)	Littoral	MNGF	71502.10
	Sundarban South WS	7	0.70 (3)	0.78 (3)	Littoral	MNGF	36970.45
	Pablakhali WS	7	0.70 (3)	0.62 (9)	Hilly	TMEF	42087.00
	Chunati WS	8	0.80 (2)	0.80 (2)	Hilly	TMEF	7763.97
	Fashiakhali WS	6	0.60 (4)	0.62 (9)	Hilly	TMEF	1302.43
	Dudh Pukuria-Dhopachari WS	6	0.60 (4)	0.66 (7)	Hilly	TMEF	4716.57
	Hazarikhil WS	7	0.70 (3)	0.62 (9)	Hilly	TMEF	1177.53
	Sangu WS	6	0.60 (4)	0.58 (11)	Hilly	TMEF	2331.98
	Teknaf WS	8	0.80 (2)	0.82 (1)	Hilly	TMEF	11615.00
	Tengragiri WS	5	0.50 (5)	0.62 (9)	Littoral	MNGF	4048.58
	Dudhmukhi WS	5	0.50 (5)	0.48 (15)	Littoral	MNGF	170.00
	Chadpai WS	5	0.50 (5)	0.78 (3)	Littoral	MNGF	560.00
	Dhangmari WS	6	0.60 (4)	0.78 (3)	Littoral	MNGF	340.00
	Sonarchar WS	4	0.40 (6)	0.42 (16)	Littoral	MNGF	2016.48

TMDF = Tropical Moist Deciduous Forest, TMEF = Tropical Moist Evergreen Forest, MNGF = Mangrove Forest

Kaptai NP with the PASI and PARTI of over 0.80. Among the 8 protected areas belonging to tropical moist deciduous forests in the plain lands, only 2 were found most vulnerable (having the PASI of over 0.80 and PARTI of over 0.70). These are Bhawal NP and Modhupur NP. Among the 11 mangrove protected areas in littoral geographical region, 6 were found extremely susceptible and threatened by the identified threat factors (having both the PASI and PARTI of over 0.7). These are Sundarban East, West and South, Chadpai WS, Dhangmari WS, and Nijhum Dweep NP. Of the total PAs, only 6 were found with both PASI and PARTI of less than 0.50. These are Ramsagar NP, Nobabgonj NP, Shingra NP, Kadigarh NP, Dudhmukhi WS, and Sonarchar WS.

The Kruskal-Wallis test showed that, for both PASI and PARTI, threat scores were higher in tropical moist evergreen and semi-evergreen forests, followed by mangrove forests and then tropical moist deciduous forests (see Table 11.3).

11.3 Discussion

Despite the undoubted contribution of protected areas to the conservation of global biological diversity (Caro 1999); multi-dimensional threats are being reported to prevail in such areas all over the world. Kideghesho (2009) reported common threats to be rapid human population increase, inadequate local support for conservation policies, limited strategies for survival among local communities and inadequate capacity of the government to fund law enforcement operations against illegal activities that subject the species and habitats to unsustainable use. In the case of Bangladesh's protected areas, many aspects of forest resource utilization have been identified as responsible for their degradation (Chowdhury and Koike 2010b), posing serious threats to the biological diversity. Of the 10 identified threats to the protected areas of Bangladesh discovered by this study, five (illegal tree cutting, harvesting NTFPs, forestland grabbing for real estate business, wildlife poaching, and environmentally non-friendly tourism) were directly or indirectly related to resource utilization.

Burdened with huge human population (1,174 people/km^2), Bangladesh's forests (17.08 % of total land area) are under threat from extreme anthropogenic pressure (World Bank 2011). Encroachment of forestland (3.3 % of evergreen hill forests, 31.9 % of deciduous plain land forests), for housing and agriculture, is responsible for much of the observed loss of biodiversity (Muhammed et al. 2008; Alam et al. 2008). In this study, encroachment was reported as a threat in almost one-third of all protected areas, and in about 63 % of protected areas within tropical moist deciduous forests distributed in plain lands. Among them Modhupur National Park is the worst victim (scoring the PARTI of 0.78), probably because of the easy accessibility and its proximity to the country's capital city. These results correspond with the findings of other studies (e.g., Alam et al. 2008; Islam and Sato 2012; Muhammed et al. 2008). Marcovchik-Nicholis et al. (2008) argued that habitat loss and fragmentation due to urban development may have the most

Table 11.3 The PASI and PARTI values of protected areas based on the forest types and geographical locations

Categories		PASI	K–W test value	p value	PARTI	K–W test value	p value
Forest types	TMDF	0.52 ± 0.04	9.88	p = 0.0059	0.55 ± 0.02	13.78	p = 0.0023
	MNGF	0.65 ± 0.03			0.69 ± 0.03		
	TMEF	0.72 ± 0.03			0.71 ± 0.01		
Geographical locations	Plain	0.48 ± 0.02	17.04	p < 0.001	0.42 ± 0.02	20.01	p < 0.001
	Littoral	0.55 ± 0.02			0.66 ± 0.02		
	Hilly	0.74 ± 0.03			0.72 ± 0.01		

TMDF = Tropical Moist Deciduous Forest, TMEF = Tropical Moist Evergreen Forest, MNGF = Mangrove Forest

serious consequences to wildlife, because it results in permanent and irreversible changes to the environment, with little chance of restoration and recovery.

Illegal logging is one of the major threats to forests in tropical developing countries, which have long been subjected to rapid deforestation and degradation driven largely by poverty and complex socio-political settings (Kaimowitz 2003). In Bangladesh human-induced removal of woody biomass, in the form of timber and fuel wood, is considered the principal cause of forest loss in the protected areas (Chowdhury et al. 2009). While several other studies (e.g., Mazumder et al. 2007; Rashid et al. 2013) claim that the rate of illegal logging in protected areas has diminished following the adoption of a co-management program in Bangladesh, it was still reported as one of the severe threats in this study with a relative severity index (RTFSI) of 0.87 (Fig. 11.1). In Bangladesh the increase in timber demand (6 %) is much higher than the increase in forest cover (1 %) exhibiting a gap between production and demand of timber; thus, an imbalanced demand–supply cycle is making the country's forest resources even more vulnerable (Rahman 2012).

Another severe threat to Bangladesh's protected areas, reported by protected area managers, was the over-exploitation of forest resources (RTFSI 0.80). Since rural households are vulnerable to a wide range of stresses and shocks that affect their livelihoods (Debela et al. 2012), and forest-rich protected areas are the fundamental sources of various livelihood options for the local communities (Chowdhury and Koike 2010c), over-exploitation is common (Figs. 11.2, 11.3). This over-exploitation results in the disappearance of certain local biodiversity, as in the case of Odisha *Cycas* in India (Singh and Singh 2011) and the wolf populations of the Pamir region of Kyrgyzstan and Tajikistan (Watanabe et al. 2010). Loss of biological diversity within already established protected areas indicates a distinct institutional/administrative weakness, especially when they have governmental support, legal protection, and formal governing organization (Oestreicher et al. 2009).

Local communities living in the forested regions of Bangladesh extract both plant and animal products from the neighboring forests (Chowdhury et al. 2007; Miah and Chowdhury 2004), and wildlife is used as a source of protein and

Fig. 11.1 Illegally extracted logs are being transported through the canal inside Sundarbans Wildlife Sanctuary

Fig. 11.2 Bamboo extraction by locals in Rema-Kalenga Wildlife Sanctuary

Fig. 11.3 Honey extraction by the local communities in Sundarbans Wildlife Sanctuary

income. Hunting wild animals for bush meat is prevalent in the tropical moist evergreen and semi-evergreen forests of hilly protected areas where some indigenous communities inhabit (Chowdhury et al. 2014). Wildlife is often an open access resource, and the cost of its production is often lower than the cost of raising livestock (Fa and Brown 2009). Poaching of selected mammals for smuggling is prevalent in mangrove protected forests of the littoral zone, mainly the Sundarbans, where the Royal Bengal Tiger (*Panthera tigris tigris*) is the iconic flagship species (Uddin et al. 2013) and subject to poaching because of the high demand for its skin and other body parts in international black markets. The spotted deer (*Axis axis*), another characteristic species of the Sundarbans, is reported to be commonly hunted for the high demand of its skin in the black market (Fig. 11.4). Robinson and Bodmer (1999) identified such unsustainable hunting and poaching of wildlife as a major global threat to biodiversity in tropical forests. Uncontrolled hunting may also undermine climate change mitigation efforts, as a reduction in the abundance of seed-dispersing animal species has been shown to, in turn, reduce the density of key carbon-storing tree species (Krause and Zambonino 2013). Many of the animals of Bangladesh have either become extinct or are at risk of extinction; 40 mammal species, 41 bird species, 58 reptiles and 8 amphibians are categorized as vulnerable or above in the IUCN Red List (IUCN 2000).

Human-wildlife conflict, which is a function of human population increase and encroachment into protected areas, is a big concern in biodiversity conservation programs. The present study discovered that conflict is prevalent in the protected areas of hill forests and mangrove forests; and mostly arises from the damage of crops and houses by elephants and attacks on humans by tigers. Human-wildlife conflict in the hilly regions of Bangladesh arises from specific problems such as crop raiding, destruction of homes, and fear of collecting water and firewood in the evening because of wild elephants (Sarker and Roskaft 2011). Barlow (2009)

Fig. 11.4 Skins of spotted deer (*Axis axis*), rescued by law enforcement teams from the possession of illegal trader

estimated a mean of 76 human deaths/year over the last 130 years in the Sundarbans, which is the highest rate within the tiger's current range. To reduce the number of human deaths, controlling the 'problem animal' could be a solution. The hunting of 'problem animals', however, is not currently legally acceptable or in line with conservation objectives to preserve the tiger population in Bangladesh. On the contrary, 2–3 tigers are being killed each year in and around the Sundarbans at the moment of their attacks on human or livestock, plus an unknown number poached, could threaten the long-term viability of the tiger population, which is estimated at about 150 adult females. Controlling 'problem animals' due to human-wildlife conflict is a global issue, and includes conflicts with Amur Tiger (*Panthera tigris altaica*) in the Far East provinces of Russia (Goodrich et al. 2011), wolves in the Pamir regions of Kyrgyzstan and Tajikistan (Izumiyama et al. 2009; Watanabe et al. 2010), lions in Maasai region of Kenya and Tanzania (Okello and Hadas 2000). Tiger conservation in Bangladesh must take into account the local socio-economic conditions of which human-tiger conflict is an important feature (Barlow 2009), as it constantly exerts considerable stress to local communities that rely on the forest for their livelihoods; more than 3.5 million people living around the Sundarbans are directly or indirectly dependent on its various ecosystem services (Giri et al. 2007; Uddin et al. 2013). Working in the forest is the only potential source of income for many people living along the forest border, and

those killed are normally the main providers of income for a family (Azad et al. 2005; Gurung et al. 2008). Moreover, human-tiger conflict also strains relationships between local communities and the authorities, and may impede management activities in protected areas; in this study the threat of 'non-cooperation from local communities for implementation of protected area activities' scored a severity index of 0.65. Increasing safety measures and compensation amounts would reduce the negative attitudes of local people to the conservation issues.

Many studies have shown that measures to reduce the threats to protected areas are more likely to succeed when local communities are socio-economically empowered and actively involved in the protected area management process (e.g., Bostrom 2012; Egbuche et al. 2009; Hjortso 2004; Idrissou et al. 2013; Kothari 2006; Marshall et al. 2007; Okech 2010). Although a participatory approach under 'co-management program' has been adapted in Bangladesh's protected areas (Chowdhury et al. 2009), significant involvement of the different stakeholders (including local communities), in terms of planning and decision making, still largely remain to be accomplished (Rashid et al. 2013). Stakeholder participation in the stages of forest planning and decision making is essential to get long-lasting and viable solutions regarding the mitigation of the threats (Bruna-Garcia and Marey-Perez 2014). Because the nature of conflicts between people and protected areas varies regionally and according to the social values and economic status of local communities, it is imperative to design participatory protected area programs to suit local needs (Sarker and Roskaft 2011). It must be recognized that the state has an important role to play in protected area governance and that these roles will often be more strategic, instrumental and, to a degree, controlling in nature, in order to ensure the fulfillment of obligations to legal institutions such as the Convention on Biological Diversity and related regional and national policies, as well as related obligations to wider society and future generations (Jones 2013). At the same time, effective co-management through a 'statutory partnership' between the state and multi-level stakeholders is necessary to overcome significant governance challenges and multi-dimensional threat factors. To achieve success in such programs, the behavior of the official organizations should be more pro-people, and the resentment and distrust against the administration by the local communities should, in turn decline.

Delays in legal procedures for land titling have also increased the threat of illegal encroachment, or 'land-grabbing'. Borras Jr. et al. (2011) informed from a World Bank report on global land grab that an estimated 45 million hectares exchanged hands in the form of land grabs between 2005 and 2009. In Bangladesh, more than 0.6 million ha of additional land was scheduled for reservation under the existing Forest Act (Choudhury and Hossain 2011). However, some cases were delayed within the official gazettement process for decades. These delays diluted the Forest Department's claim to the land title and provided opportunities to vested interest groups to make counter claims. These groups then acquired land and filed title suits, leading to numerous legal disputes with the Forest Department. The sub-judicial ownership of the land under title suits, and questionable ownership of the land that was due to be gazetted, present serious hurdles in implementation of

conservation programs in Bangladesh. Land-grabbing is a major threat to biodiversity conservation and has resulted in serious conflicts in many regions of the world (Borras Jr. et al. 2011). In Sub-Saharan Africa it has been subject to conflict, conquest, expropriation and exploitation thus resulting in many chaos and social discrepancies (Bob 2010). In Bangladesh, big business companies and power holders (e.g., real estate, shrimp culture etc.) use a wide variety of market and non-market, economic and extra-economic, as well as legal and illegal mechanisms to establish control over lands held by the state forest authority or the poor peasantry (Adnan 2013). Processes leading to forest loss within protected areas are thus different to those that drive habitat loss on other land tenure arrangements that lack such formalized government property rights status (Petursson et al. 2013). Controlling encroachment and associated activities is a difficult endeavor unless there is a strong and effective political commitment from the government.

Lack of integration at policy level was reported to be a threat to biodiversity conservation, hampering the implementation of any new projects in the forestry sector, and within protected areas. During field implementation of forestry programs, overlapping sectorial policies in some cases lead to contradictions, conflicts and confusion (Muhammed et al. 2008). In addition many protected areas and other forest units lack management plans (Choudhury and Hossain 2011). This lack of management planning is not unique to Bangladesh; more than two-thirds of the world's protected areas lack a management plan, and where such plans exist, they very rarely address issues associated with sustainable livelihoods or ecosystem services (Ervin 2011). In addition to such policy level disorganization, the implementation of conservation programs is further constrained by institutional corruption. As with many other developing countries, corruption is a common problem for the Forest Department in Bangladesh. TIB (2000) reported the common incidence of cutting and selling of trees by timber traders and smugglers, and killing of animals by poachers with the direct cooperation of forest officials through bribery, embezzlement and misuse of administrative power. Corruption thus seriously impairs the sustainability of forest conservation and protected area program implementation in Bangladesh (Choudhury and Hossain 2011; Isalm and Sato 2012).

The highest ranked threat in this study of the protected areas of Bangladesh was the paucity of funds. All the protected areas are facing the acute threat of fund shortage, hampering the sustainability of forest protection and biodiversity conservation programs. Bangladesh is a developing country and, having extreme resource constraints, its government cannot allocate sufficient funds from the public budget to the forestry sector, because of other priorities. (Mulongoy et al. 2008). In Bangladesh, in the decades of 1970s and 1980s, almost 95 % of the Forest Department's budget was met by the exchequer. However, in the last two decades it has completely turned around, and presently over 80 % of the expenditures are met from the donor-funded project-based development budget. Therefore, when there is no externally funded project, there is no funding for forestry activities. The flow of development funds is often short term (4–5 years) and unreliable and cannot be the basis for a long-term national program, such as the protected area network of Bangladesh. This funding model is the most serious

problem for the forestry sector, frustrating the long-term visions and commitments of biodiversity conservation in the country (Choudhury and Hossain 2011). Suggested solutions include the creation of a 'Trust Fund' for Bangladesh's protected area network, which could be established by international donors (Baldus 2008), and given appropriate checks to prevent misuse of funds.

Another potential source of funds for protected area management comes from ecotourism. Not all the protected areas of Bangladesh are attractions for tourists; there are only a few which are enriched with magnificent scenic beauty and gorgeous biodiversity (EWI 2009). Eco-tourism has been promoted in those protected areas in the recent past by the Forest Department as the legal controlling authority of the country's forestlands. Since the 1990s, many developing countries rich in biodiversity have been vigorously promoting eco-tourism as a conservation and development tool in their protected areas (He et al. 2008). From a community perspective ecotourism can provide benefits (revenues from lodging, food, guiding and transportation to tourists) that ultimately enhance local support for the conservation of natural resources due to the direct link between biodiversity conservation and local development (Rana et al. 2010, Lambooy and Levashova 2011). The collected revenues from visiting a protected area could support its preservation. However, when inadequately managed, visitors' activities can result in degradation of the landscape, and have negative impacts on wild plants and animals (Kimura 2011), including impacts on the socio-psychological behavior of wildlife, as evident from the outrageous behavior of elephants in the Rajiv Gandhi National Park, India resulting from the severe anthropogenic interference in their regular trenches (Ramchurjee 2013). Sometimes, this industry encourages encroachment to forestlands as the case in Costa Rica where because of tourism development, land clearance for the construction of large hotels without any proper spatial planning has become a big problem (Koens et al. 2009). The national parks of Himchari, Lawachara, Kaptai, Satchari, Khadim Nagar, Kuakata and the wildlife sanctuaries of Rema-Kalenga, Sundarbans (East, West and South), Chunati, Sangu, and Teknaf are the protected areas most negatively affected by tourism. Generally, ecotourism is a tool that can help to improve the well-being of local people (Anup and Parajuli 2014) and minimize the environmental effects of regular tourism such as littering and vegetation damage by the visitors (Gossling 1999; Ramchurjee 2013).

11.4 Conclusion

With limited land and a huge population, Bangladesh is facing various anthropogenic threats to its forest resources. Administrative procrastination and corruption, along with the evil political illegitimacy, encourage these unlawful activities, which in turn, affects the biological diversity both directly and indirectly. The types and patterns of the threat factors in Bangladesh's protected areas are complex. These findings suggest that existing strategies relating to biodiversity

conservation in protected areas are inadequate. Efforts to reduce the threat factors need to be fully integrated into the forest conservation and development programs driven both by the government and the donors. Systematic and concerted attention is required to make the recently adapted co-management programs realistically successful. Proper and functional partnership between multi-sectorial stakeholders such as the government, forest user groups and local communities, donor agencies, and civil society groups is a pre-requisite for success. Findings of the present study could provide the useful information for policy makers developing new programs of biodiversity conservation in the country.

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Chapter 12
Conclusion and Recommendations

Mohammad Shaheed Hossain Chowdhury, Masao Koike and Shigeyuki Izumiyama

This book addressed a number of issues under the broad topic of protected area focusing on the policy of collaborative management as a means to augment the forest conservation activities and enhance the community development. Realizing the malfunction of traditional forest management in Bangladesh, the government explored and implemented few alternative strategies for better management of the country's forest resources. Establishing protected areas was the first scheme of such strategy. But simple declaration of protected areas has not functionally worked in the prevention of the loss of biodiversity. Because, local communities face hardships after a forest is notified as protected area. This is mainly due to the curtailment of the flow of forest resources for their livelihoods through strict regulations. Therefore, considering the pragmatism, the government initiated collaborative management approach with the active participation of local communities in five protected areas as pilot projects.

The studies covered in this book revealed that the implementation of co-management policy has positive impacts on the development of surrounding communities. Based on the lessons from the researches on Rema-Kalenga Wildlife Sanctuary, Lawachara National Park, and Chunati Wildlife Sanctuary, a general metaphysical model, namely 'Spider-web model of protected area co-management' has been developed that can be potentially applicable wherever local communities rely heavily on protected areas.

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M. S. H. Chowdhury (ed.), *Forest Conservation in Protected Areas of Bangladesh*, World Forests 20, DOI: 10.1007/978-3-319-08147-2_12,

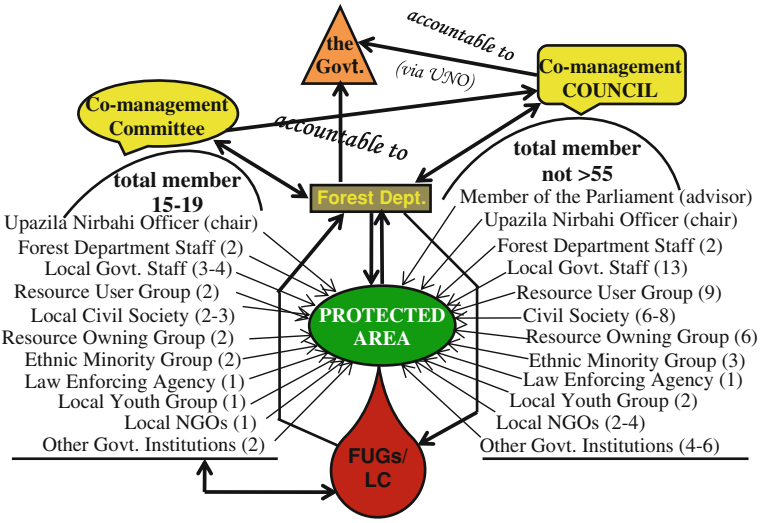

Fig. 12.1 Spider-web model of protected area co-management

The model consists of six broad social elements, the relationships among them (Fig. 12.1), and types of activity suggested for each group (Boxes 3, 4 and 5). The elements are the protected area itself; the forest user groups (FUGs)/local communities, co-management committee, co-management council, the forest department and the government, where the protected area remains the focal concern of the other five elements. The FUGs are considered the main stakeholders, formed from the local communities and supported by the Forest Department. The co-management committee and co-management councils are proposed to form by the combination of members with the representation of different segments of the society. Co-management committee will have the direct relationship with the FUGs by guidance and running of group activities, whereas co-management council has the duty of supervising the co-management committee and reporting to the government. It has the relationship with the FUGs too. The Forest Department is considered to be the level of socio-political organization with its local office and will act as the facilitator in the whole process who will make efforts to help the FUGs achieve the conservation and development goals of forest resources and local communities, respectively.

The different colors used to mark different elements in the model has the significance according to the Goethe's Theory of Colors (Goethe 1810), which provided the first systematic study of the physiological effects of color (Chapman 2010). Red is the color of blood that stands for energy, force, strength, power and determination. It is a color of leadership and also a color of the pioneer. In the model, the FUGs who are the integral part of local community are denoted by red because they are considered the life blood of the co-management system of protected area without recognizing the usufruct rights of whom on the forest resources, any kind of conservation or development project will fail to achieve the

goals accordingly. Green is the color of nature. It symbolizes growth, harmony, freshness and fertility. The protected area is signified by green in the model because of its multiple functions of tangible and intangible nature. The Forest Department is marked with brown, the color of earth that shows a secure and slower force. It is the color of endurance too. In the model, the Forest Department is considered one of the most important elements with huge responsibilities of organizing, supporting and training the FUGs, and maintaining liaison among the other elements to achieve the success of the whole process. In doing such huge responsibilities, it should develop the receptive mindset to face any kind of troubles arising from various corners of the process. Yellow is friendly and cheerful. It produces a warning effect, arouses cheerfulness, stimulates mental activity and generates mass energy. It shows the social energy and indicates a lot of cooperation from others. Yellow is not a color of leader, rather, it prefers to follow. In the model, both the co-management committee and co-management council are denoted by yellow because the basic functions of these two elements are to make the whole process by their role of supervisors, monitors and inspirers. Finally the color orange is used to symbolize the government being placed at the top of the whole process. Orange is the sun color and full of energy. It shows things that move fast and that have great strength of purpose. It represents the energy that enjoys giving to others. It can indicate all growing things and new beginnings. The government is the policy making authority in a country where development projects cannot be successful without the political commitment from its part. Good governance and favorable policies along with financial, administrative, and institutional supports can enhance the development projects.

Box 12.1 Recommendations for the Forest User Groups (FUGs)

(i) Arrange the group meetings regularly
(ii) Identify the forest conservation and local development concerns
(iii) Ensure that the whole community is involved in problem identification
(iv) Create the awareness on forest conservation by yard meetings
(v) Convince the community members to participate in conservation scheme
(vi) Identify priority species and sites within the protected areas for improved management
(vii) Develop local teams to take care of these species of plants and wildlife
(viii) Seek recognition of community rights over the non-timber forest products from protected areas
(ix) Increase own involvement in alternative sources of livelihoods and encourage others to be involved
(x) Cooperate the Forest Department in executing the conservation efforts.

Box 12.2 Recommendations for the Co-management Committee and Council

(i) Be punctual, honest and dedicated to the responsibilities assigned by the govt.
(ii) Enlist and approve the AIG activities that reflect the real needs of the community
(iii) Maintain the equity and equality in proposing the name of FUG members for training on AIG activities
(iv) Give up the practice of nepotism in benefit sharing
(v) Convince the authority to recognize the usufruct rights of local community on the forest resources
(vi) Encourage the FUG members to participate actively in meeting discussions
(vii) Keep the record of meeting minutes and submit to the higher authority regularly
(viii) Encourage the community to adopt new livelihood options
(ix) Increase the direct interaction with the root level community members. The higher level personnels of the government such as Member of the Parliament and Upazila Nirbahi Officer (UNO) may make regular visit to the community to see the program activities, discuss with the FUGs and share the government's policy. It will create the sense of prestige among the participants.

Box 12.3 Recommendations for the policy makers (Forest Dept. and govt.)

(i) Play the role of facilitator rather than that of dictator to the local community
(ii) Learn from the local people by exploring the indigenous knowledge
(iii) Emphasize on maintaining the equity and equality on distributing incentives
(iv) Fix a limit of resource extraction and allow the community to harvest NTFPs
(v) Develop plant-based small-scale enterprises and engage the community in them
(vi) Encourage the cultivation of medicinal plants in buffer zones on commercial basis

(vii) Supply the quality planting materials for such cultivation and give training on WHO guideline on 'good agricultural and collection practices (GACP) for medicinal plants'
(viii) Develop markets for medicinal plants and finished products from small-scale enterprises
(ix) Strengthen the forest patrolling teams with training, equipments and funds
(x) Develop protected area based ecotourism industry, establish hygienic infrastructures and give training to community on the profession of tourist guide
(xi) Encourage the NGOs and private organizations to involve in conservation activities and strengthen public-private partnership for integrated management
(xii) Promote awards and incentives for the best contributor in conservation activities
(xiii) Give compensation to the families suffered from the human-wildlife conflicts
(xiv) Appoint skilled personnels for the whole process
(xv) Encourage intensive researches on how to improve the co-management process
(xvi) Allot sufficient funds for enhancing and sound accomplishment of such projects
(xvii) Replicate the co-management approach in all protected areas gradually
(xviii) Take trans-boundary initiatives with India for the protected areas in the Sundarbans mangrove forest
(xix) Arrange seminars, workshops and conferences on nature-people interface with the special focus on protected areas
(xx) Launch political commitment to the conservation of forests and biodiversity

From the present study, the importance of government policy for determining conservation policies at the community levels is evident like many other international experiences (e.g., Wells and McShane 2004; Martinez 2007; Baral and Heinen 2007a, b; Shengji et al. 2010). According to Shengji et al. (2010), relevant policy fields include policies towards indigenous groups and local autonomy, national healthcare, agriculture and land use, natural resource management, and the orientation of research institutes. The conservation policies need to be monitored carefully to ensure the compatibility with the other existing relevant ones.

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M. S. H. Chowdhury (ed.), *Forest Conservation in Protected Areas of Bangladesh*, World Forests 20, DOI: 10.1007/978-3-319-08147-2,