

# Chapter 2

## Conceptual Framework, Research Methods and Approaches

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### 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

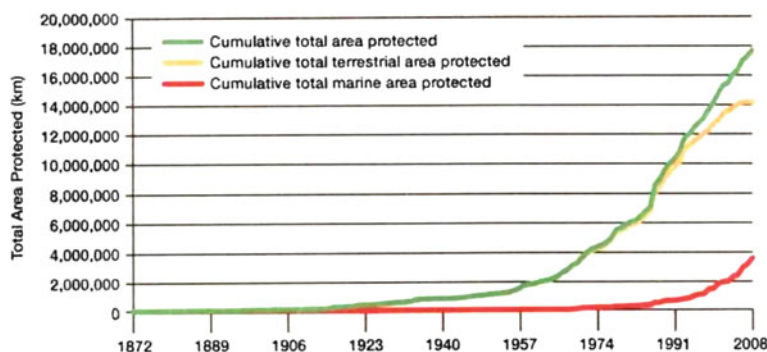
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**Fig. 2.1** Growth in nationally designated protected areas from 1872 to 2008 (Adapted from BIP 2010) (Graph excludes protected areas with unknown year of establishment)

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 interspersed 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.

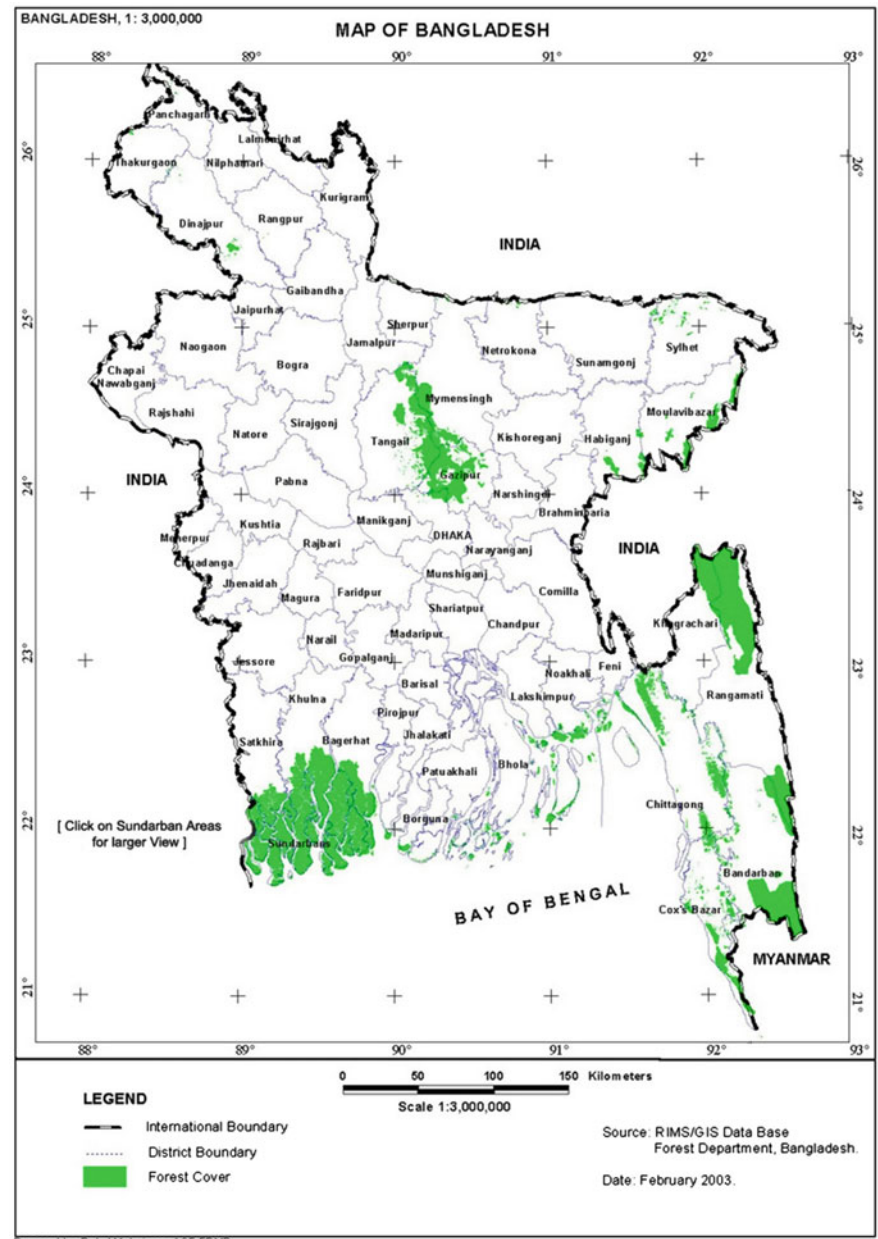


Fig. 2.2 Map of Bangladesh showing the distribution of protected areas (marked green)

## **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.



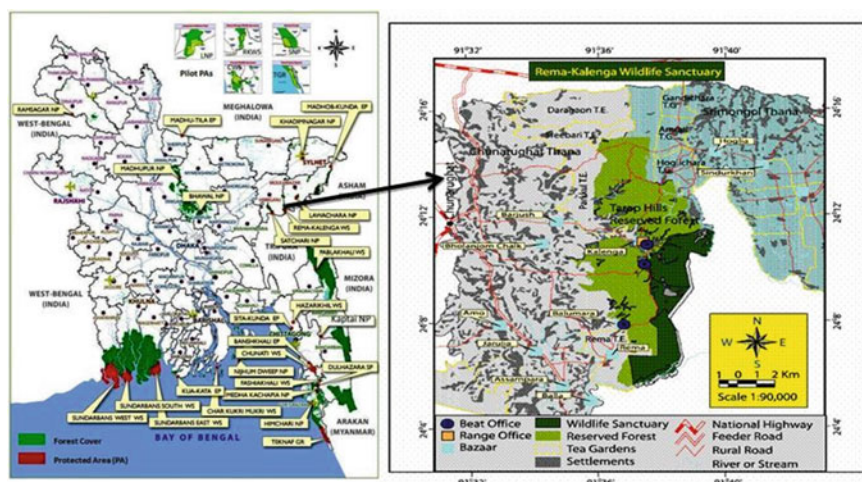


Fig. 2.3 Map of Rema-Kalenga Wildlife Sanctuary, Bangladesh

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

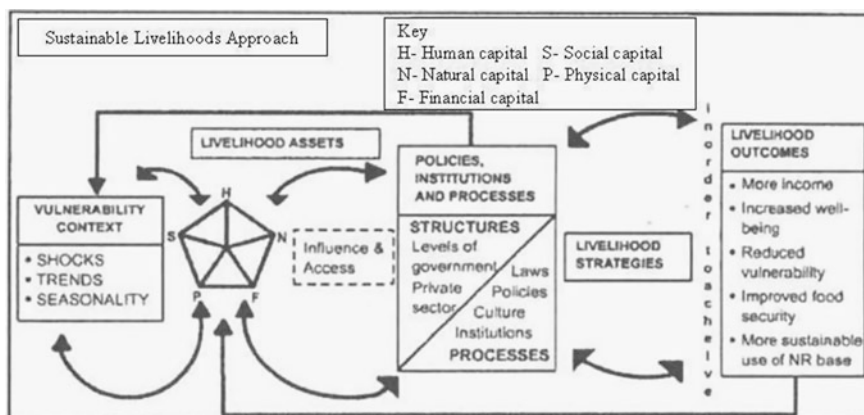


**Fig. 2.5** Sample of two such community sketches developed on-site

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 is 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

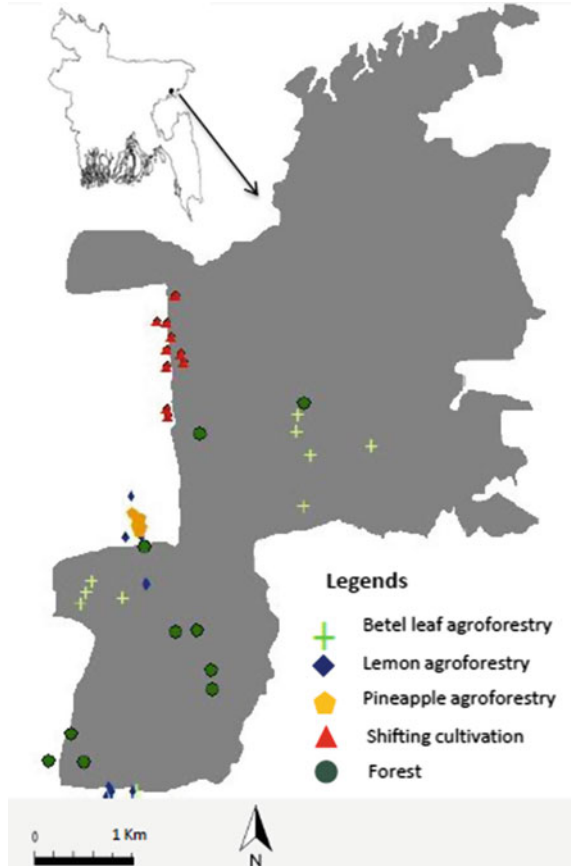
The study was conducted in and around Lawachara National Park, Bangladesh (Fig. 2.7). Geographically the park lies between 24°30'–24°32'N and 91°37'–91°39'E. The area of the park is, 1,250 ha (12.5 km<sup>2</sup>), and it is one of the richest forest patches in country marked by diverse wildlife, plants 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  $\geq 6$  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  $\geq 1.3$  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 ( $3 \times 5$  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 ( $5 \times 5$  replicates) were collected from four agroforestry land-uses ( $5 \times 4$ ) and from forests ( $5 \times 1$ ). 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  $178 \text{ cm}^3$  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):

$$H = - \sum_{i=1} p_i \ln p_i \quad (1)$$

where,  $H$  is the Shanon Index,  $p_i$  is the proportion of individuals found in the  $i$ th species.

Jaccard's similarity index ( $I$ ), was used for measuring beta ( $\beta$ ) 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),

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

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



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

where,  $\exp. = [\dots]$  means “raised to the power of  $[\dots]$ ”;  $B$  = 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  $\text{tonne/m}^3$ .

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;

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

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  $\text{gm/cm}^3$ ).

## 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'<sup>1</sup> 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**

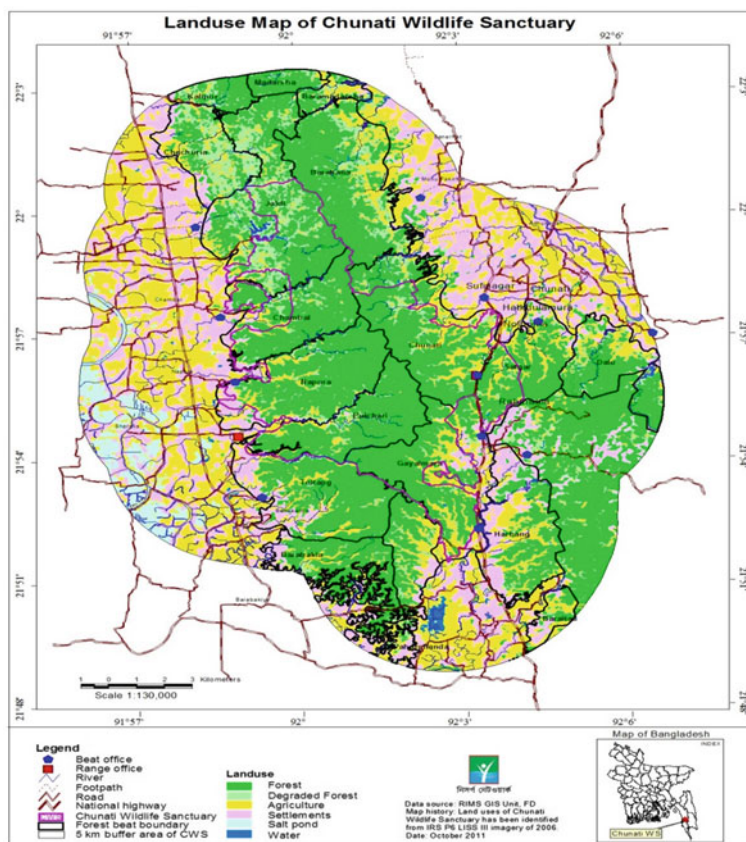
Six villages were selected randomly considering three parameters, viz., village position, degree of dependency on the sanctuary, and ethnicity of the community (Table 2.1). Using a reconnaissance survey and consultations with the local leaders, a list of the FUG households from each village was ascertained.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

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<sup>1</sup> 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
<i>Debrabari</i> (n = 30)	Inside/core zone	Heavy	Tribal
<i>Chanbari</i> (n = 34)	Adjacent/buffer zone	Heavy	Tribal
<i>Kalengabari</i> (n = 54)	Adjacent/buffer zone	Heavy	<i>Bangalee</i>
<i>Jamburachara</i> (n = 48)	Adjacent/buffer zone	Medium	<i>Bangalee</i>
<i>Harinmara</i> (n = 84)	Outside/outer zone	Medium	<i>Bangalee</i>
<i>Krishnanagar</i> (n = 52)	Outside/outer zone	Low	<i>Bangalee</i>

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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Policy and community development perspectives

Mohammad Shaheed, H.C. (Ed.)

2014, XVI, 258 p. 55 illus., 49 illus. in color., Hardcover

ISBN: 978-3-319-08146-5