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Community-Based Forest Management (CBFM) in Bangladesh

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Community-Based Forest Management (CBFM) in Bangladesh

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Foreword

Community forest management in Bangladesh started with Betagi-Pomra project during the late 1970s. It was conceived by Prof. Abdul Alim, the then Conservator of Forests who tried to rehabilitate naked man (in his language meaning that extreme poor living around forests) in naked hill (hills without any tree cover). He was supported by a Bureaucrat Mr. Mahbubul Alam Chashi with his legal support and present Noble Laureate Prof. Muhammad Yunus with his knowledge of working with people. They identified a local leader who happened to be a school teacher—Quddus Master—a very successful organizer. Being a Senior Scientific Officer of Bangladesh Forest Research Institute (located near to project site) during 1977 to 1986, I was responsible for monitoring the project. It emerged as most successful in terms of greening the hills, mobilizing communities in conservation of forests, and creating ownership including empowering them in taking decision about their products. After having land title in Betagi, they took serious interest in improving management of their land and increase productivity further integrating high-value fruit trees.

The success of Betagi-Pomra led to undertake community forestry project by the forest department (FD) in encroached plain land Sal (*Shorea robusta*) forest land of northern Bangladesh which was funded by Asian Development Bank during early the 1980s. While in Betagi-Pomra project all benefits were enjoyed by the communities in Community Forestry Project of northern Bangladesh, the benefit was shared among the community and FD. Trees were planted in nine different modules to understand the preference of people and productivity of land without sacrificing basic forestry principles. It was found that alley cropping having 2–3 rows of fast growing trees with 10-m alley was found to be most preferred planting pattern by the community. The rotation was set at 10 years, and preferred species were *Acacia auriculiformis*, *Eucalyptus camaldulensis,* and *Cassia siamea*. Though the preferred module was alley cropping, unfortunately the agricultural production declined seriously after three years and they abandoned growing any crops after 4–5 years. However, the community was happy to have a kind of right on the forest land for growing agricultural crops and having benefit from growing trees (50 % share from final harvest and 100 % pruning and thinning products).

The success of community forestry was scaled up in other forest areas in the country gradually. The FD moved further from community forestry to co-management during early 2000 for management of protected areas which integrated lessons of community forestry and traditional forest management. The FD attempted to share governance of protected areas with communities, but for such a paradigm shift, most of the forest officers were not ready technically and attitudinally. With USAID-supported Nishorgo project, five protected areas were brought under co-management. There were several studies which claimed that for effective forest management, co-management is the solution. Co-management is sharing governance between FD and the communities including other stakeholders who are linked with people living around forests and forest products. Based on the success, government has developed legal instrument to support co-management. After completion of Nishorgo project, a follow-up project was developed called Integrated Protected Area Co-management (IPAC) which is followed by Climate Resilient Eco-System and Livelihood (CREL). Many researchers and social scientists studied the success and limitation of the systems practiced under different projects. Beside USAID-supported Nishorgo, IPAC, and CREL projects, Arannayk Foundation had also been piloting co-management including community-based forest conservation in protected areas, reserve forests, and even community-conserved areas. Though we had our own observations, we engaged independent reviewers to critically look into success and failure including strength and weakness of our initiatives.

It was necessary to have a comprehensive study and documentation of the results of all initiatives. Thanks to the authors of this book who tried to make a critical analysis of success stories and lessons learned from all studies including their own studies in different forest areas. They have rightly identified the strength and weakness. They have identified sharing authority to take decision by the community as one of the main weakness which is absolutely correct. The other main weakness is lack of beat level authority to coordinate with community for making the process vibrant. They have rightly identified that it is community patrol group which is most effective under co-management system, but general body and executive committee of the co-management system are composed of different stakeholders having their own work pressure which is not as effective as claimed. There is need for empowering communities living in and around forests. It is also necessary to create ownership of the forests so that they can feel that the forests around them are by the community and for the community.

Thanks to the authors for an excellent critical review of all the important initiatives taken so far by the FD and other related agencies. The readers will be immensely benefited from this book and will have a clear understanding of co-management system prevailing in Bangladesh.

Dhaka, Bangladesh
April 2016

Farid Uddin Ahmed
Executive Director (Arannayk Foundation)

Preface

The top-down approach of forest governance is nowadays not an appropriate approach of forest management especially where dependency of locals on forest resources is high. This kind of forest management, in greater extent, has failed to achieve the desired goals of forest conservation and revenue generation. This failure of state-governed forest management and the subsequent misery of forest-dependent poor people had knocked the developing governments and development agencies to involve local people in forest governance. During the last three or four decades, this kind of forest governance has undergone several changes and community-based forest management (CBFM) has been established as a means of sustainable forest management particularly in developing countries. Bangladesh is no exception which initiated various types of CBFM in the early 1980s. Recently, the CBFM in Bangladesh has been intensified but it is not certain how far this approach has achieved the targeted goals. In this book, drawing empirical data from four different CBFM sites, we evaluate performance of different approaches. This is a comprehensive work, for the first time too, to compare different approaches of CBFM and hence might be a useful reference book for forestry professionals, policy makers, researchers, faculty members and students, and development agencies working on natural resources management.

Chapter 1 presents the background of the inception of community-based forest management (CBFM) in tropical countries, and Bangladesh in particular. It also sets the aim(s) and outline of this book. The CBFM programs have been promoted in many countries as an innovative and potential approach to improved forest management and conservation strategies with a comprehensive blend of ecological and socioeconomic objectives. Many countries have now developed, or are in the process of developing, changes to national policies and legislation that institutionalize the CBFM. The government of Bangladesh has also put emphasis on the CBFM since the early 1980s, and a number of forestry projects have been implemented with the participation of local community having both success and failure in intended project outcomes.

Chapter 2 describes the evolution of CBFM in Bangladesh. Although Bangladesh forest has a history of more than 100 years of scientific forest management, CBFM is a recent intervention. In Bangladesh, this approach has been evolved from a policy emphasis over commercial production towards a more people-centric model designed to support the conservation of forest resources. First introduced in the late 1970s, community forestry, a form of CBFM, has proven a successful model for reforestation, afforestation, and diversifying economic opportunities in rural communities. The 1994 Forest Policy, the Forest (Amendment) Act of 2000, and the 2004 Social Forestry Rules are considered milestone achievements for the implementation of CBFM in Bangladesh. The CBFM has succeeded in reducing distrust and conflict between forestry officials and local people, encroachment on forest lands, and the deforestation rate. But, program implementation has faced roadblocks that stem from a top-down bureaucratic approach and poor governance system.

It is about 35 years that the Betagi-Pomra community forestry (CF) had been implemented. In chapter three, we investigated the impact of Betagi-Pomra CF on livelihoods of participants by employing DFID's sustainable livelihood framework. Analysis of BP (beginning of the project) and AP (at present) data shows significant positive changes in all livelihood capitals due to the CF activities. The degraded forests have now been converted into plantations. One of the potential threats that might jeopardize the goals of CF in the project sites is the continuous fragmentation of land. Fragmentation of allocated CF plots due to population growth and division of family seems a serious menace for the sustainability of CF. Regular monitoring by the FD staff members and, if necessary, review of agreement might be helpful to prevent land fragmentation.

Drawing on data from the Chunati wildlife sanctuary (CWS) in Chap. 4, we examined peoples' dependency on forest resources of CWS, forest health conditions, functions of co-management structure at local level, and impact on forest conservation. Household and forest trail surveys show that local people are heavily dependent on CWS's forests for own use and income. Local people clear forest land for betel leaf cultivation, sungrass production, and other agricultural practices. Forest vegetation survey recorded 93 tree species with a density of 239 trees/ha of which seven (07) exotic species contributed 60 %. Nearly 90 % trees belong to 5–15 cm dbh (diameter at breast height) producing a minimum biomass of 33.3 t/ha. We observed a four-tier co-management governance structure at local level consisted of village conservation forums (VCFs), peoples' forums (PFs), community patrol groups (CPG), and co-management committee (CMCs) with each component has their own functions. We found a lack of coordination among local level co-management structure, Nishorgo Support Project (NSP), Integrated Protected Area Co-management (IPAC), and forest department (FD). Although CMC was empowered by a government order to perform PA management-related functions, but NSP or IPAC took all managerial decisions. In official documents, there was existence of VCF, but we noticed no activities during baseline survey although later on they were involved with GIZ project. The gap between promises and actual provisions had created distrust between CPG and others (CMC, NSP,

IPAC, and FD). However, CPGs' continuous patrolling reduced the incidence of illegal logging, and the CWS is regaining its old forest growth. We recommend several policy implications for reducing misunderstandings among stakeholders and to ensure sustainability of PA co-management in CWS.

Chapter 5 focuses on the historical background of village common forests (VCFs) in the Chittagong Hill Tracts (CHTs) and, then drawing on empirical data from Komalchari VCF, examined peoples' dependency, indigenous management, and forest health. Although public forests have been degraded seriously, the indigenous people in the CHT have been managing VCF sustainably for at least 200 years. It was found that not only members of the VCF but also neighbors depend on VCF's resources for fuelwood, bamboo, timber, vegetables, wild fruits, vines, or medicinal plants. The VCF is vital source of water supply and a storehouse of local biodiversity. The vegetation study identified 94 plant species with a mean density of 587 tree/ha and a mean aboveground biomass of 453 t/ha. The VCF has been managed by informal indigenous rules. All villagers have equal access to resources and equally contribute to the protection and development of VCF. However, population pressure combined with improved marketing facilities, over-exploitation, personal greed, and tenure insecurity are exerting pressures on VCF. Recognizing the traditional and customary resource rights of the indigenous communities, acknowledging resource management system, providing tenure security, encouraging communities through legal and financial incentives, and at the same time upholding the spirit of CHT Peace Accord 1997 could be important policy tools for the sustainability of VCF in the CHT.

Community participation is now considered as an important element of any development programs. For development, adoption, and promotion of any agricultural technology, effective community participation is essential. In Chap. 6, we discuss the process and level of community participation in agroforestry development, state of agroforestry, and participant's opinion on sustainability of agroforestry. We also discuss the challenges and opportunities of agroforestry development. Considering participant's preference and experts' opinion, crop combination was selected and an agri-horti-silvicultural type of agroforestry system was developed. Even though participants used to grow agricultural crops along hillslope every alternate year, now they cultivate every year across the hill slope. A benefit–cost ratio for agricultural crops was estimated at 3:1. Planted seedlings are growing well, and average survival rate is more than 70 %. More than 80 % participants are interested to continue agroforestry even after project funding ends and 54 % of them desire to expand agroforestry in other areas. Even though they have been rigorously motivated, some participants did not work according to project authority's recommendations. For future development and promotion of agroforestry by involving ethnic communities in CHT, it is suggested to work closely in small areas in collaboration with local partners.

Chapter 7 illustrates a comparative scenario of four CBFM interventions in terms of socioeconomy, forest attributes, and legal, social, and management, and resource system-related characteristics. Socioeconomic attributes reveal that villagers in respective area depend on forest resources (fuelwood, bamboo, timber, leaves,

sungrass, vegetable) for cooking energy, house construction materials, food, and household income. Both VCF and Chunati PA are rich in plant species composition, but tree density is highest in Betagi-Pomra CF. Individual land ownership in Betagi-Pomra CF encouraged villagers to plant fast growing and high yielding tree species. Individual ownership, users' management rights, well-defined boundary, small resource system, and social equality ensure relatively more sustainable management of forests in Betagi-Pomra CF, VCF, and AF projects than that of Chunati PA. Some policy implications are suggested for sustainability of various CBFM approaches and recommendations are made to incorporate REDD+ schemes, introducing mutual rotating fund and collaboration of corporate agencies in CBFM.

This book is the result of our extensive fieldworks in southeastern part of Bangladesh. Many people were involved in the fieldwork, and villagers were very much enthusiastic and cooperative. Our sincere gratitude goes to these people who spent their valuable time with us during the fieldwork. Many students of the Institute of Forestry and Environmental Sciences, University of Chittagong, Bangladesh, assisted us in field data collection. We are thankful to them. The field studies were funded by several NGOs, the Arannayk Foundation, Bangladesh Agricultural Research Council (BARC), the University of Tokyo, and the Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ) GmbH, Bangladesh. We sincerely acknowledge their support. The officials of Wildlife & Nature Conservation Division, Chittagong, Bangladesh, provided logistic support during fieldwork in Chunati Wildlife Sanctuary. We are very much grateful to them. Thanks to Jules Pretty (University of Essex) and Farid Uddin Ahmed (Arannayk Foundation) for their valuable comments on the draft.

Selangor, Malaysia — Tapan Kumar Nath
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April 2016

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Chapter 1
Introduction, Aims, and Outline

This chapter presents the background of the inception of community-based forest management (CBFM) in tropical countries, and in particular Bangladesh. It also sets the aim(s) of this book. The CBFM programs have been promoted in many countries as an innovative and potential approach to improved forest management and conservation strategies with a comprehensive blend of ecological and socioeconomic objectives. Many countries have now developed, or are in the process of developing, changes to national policies and legislation that institutionalize the CBFM. The government of Bangladesh has also put emphasize on the CBFM since the early 1980s and a number of forestry projects have been implemented with the participation of local community having both success and failure in intended project outcomes. In this book, we aim to shed light on evolution of the CBFM in Bangladesh and critically evaluate the performance of various CBFM practices. Stress is given on how to sustain the CBFM and integrate these into (i) carbon forestry projects (e.g., REDD+) for meeting the triple benefits of forest management: poverty reduction, forest conservation, and climate change mitigation; (ii) mutual rotating fund for creating alternative income generation opportunities so that dependency on forests is reduced and (iii) corporate social responsibility activities of corporate agencies so that they provide funding for environmental conservation and social development. These strategies might facilitate sustainability of CBFM in Bangladesh. So far our knowledge goes, there is no such book publication available in Bangladesh. Therefore, we believe that this publication would fill this gap and be useful for scholars, policy makers, and students as a reference book.

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1.1 Emergence of CBFM: A Historical Overview

In varied times and places, communities have long been managing forests—that is exploiting, sustaining, and manipulating them for productive purposes, sometimes in a collective manner (McDermott 2009). Local communities base their forest management on traditional knowledge and own rules sufficient to sustain the biophysical condition of their forests resulting long-term ecological sustainability in compatible with locally set priorities (Hayes and Persha 2010; Rutt et al. 2015). However, expropriation of forests by governments as forest reserves or some other form of state property thwarts local peoples' access to forest use and management, and led to progressive degradation of the remaining forests (Arnold 2001; Roy 2002). The expansion of forest reservation restricted access to remaining forests due to lack of land tenure and intensified state control led to the poverty of forest-dependent people (Fisher and Hirsch 2008). Exclusion of local people from state forest management, under conditions where dependency of the people on forest resources is high due to poverty and high population density, was not an appropriate policy because it does not automatically ensure protection from forest degradation or the avoidance of greater environmental problems (Gunawan et al. 2004). To pursue conservation agendas by restricting access to forest resources relegate the rural poor to levels of livelihoods deprivation that entail health problems, loss of life, distress migration, social disaffection and conflicts (Mamo et al. 2007). Although most of the centrally managed government forest areas were designated as management solutions for forest, water, and biodiversity conservation under strict restriction and denying the needs of adjacent communities, they failed to curb deforestation and resource overexploitation (Bruner et al. 2001; Kellert et al. 2000; Borrini-Feyerabend 1996; Berkes 2004; Elbers 2008; Garcia-Frapolli 2009; Moorman et al. 2013; Dressler et al. 2015).

The failure of centrally administered and top-down regulatory forest regimes to manage forest resources sustainably stirred policy makers and scientists to devise polycentric resource management strategies allowing wider participation of relevant stakeholders including local population in the management process. This had led to decentralization of forest governance in many countries. In recent decades, decentralization and securing citizens' participation have emerged as core strategies to achieve improved forest management and better livelihoods as well as democratic participation and enfranchisement of forest-dependent people (Kumar et al. 2015). Gilmour (2016) identified various events that had influenced the emergence of people-oriented community-based forestry (CBF) (Table 1.1).

For the last few decades, various participatory approaches and decentralized policy frameworks have been applied to the management of local forest resources through transfer of powers to local communities (DANIDA 2007; Claude et al. 2008; Tachibana and Adhikari 2009; Casse and Milhoj 2011; Dressler et al. 2015; Kumar et al. 2015). Policy makers in both developed and developing countries have

Table 1.1 Key global forest-related developments that have influenced the evolution of CBF (Gilmour 2016)

Period	Events	Response
1970s	Fuelwood crisis	Initiation of forestry for local community development
	Failure of forest industry development model to sustain forests and meet community needs	Establishment of fuelwood plantations (generally top-down); many failed
1980s	Large-scale deforestation; environmental degradation	Pilot projects tested CBF modalities in different settings to address environmental concerns
	Forest sector reforms: decentralization and devolution policies	Emergence of "people's participation" and bottom-up development
1990s	Sustainable development paradigm	Focus on sustainable forest management and livelihoods as CBF objectives
	Recognition of indigenous peoples' rights	Establishment of CBF regimes that formalize indigenous peoples' rights to manage forests
		Expansion of CBF across all regions
2000s	Globalization, trade liberalization	Growing interest in commercialization of wood and non-wood goods and services produced under CBF
2010s	Global policy focus on climate change, illegal timber, and payment for environmental services	Additions to CBF objectives to address global policy interests

adopted decentralization[1] reforms as a strategy to improve public sector performance (Andersson 2004; Chatterji 2001; Shackleton et al. 2002) and to achieve developmental goals, provide public services, and undertake environmental conservation (Agrawal and Ostrom 2001; Ribot 2004). Decentralization can improve fairness in decision-making either through the delegation of administration or devolution of governance from central government to local communities (Ferguson and Chandrasekharan 2004).

Decentralization allows participation of stakeholders in comanagement of forest resources, and devolution of forest management responsibilities to local

[1]Decentralization is the relocation of administrative functions from central location to local levels closer to those who are most affected by the exercise of power (Agrawal and Ribot 1999; Fisher 1999, 2000; Agrawal and Ostrom 2001; Larson 2004). It is considered as a tool that promotes development and increase efficiency, equity and democracy by bringing decision-making closer to local people (Ferguson and Chandrasekharan 2004; Larson 2004; Ribot 2004). Decentralization can take place in different forms: deconcentration, delegation, and devolution (Klugman 1994 cited by Ferguson and Chandrasekharan 2004). Deconcentration means the transfer of administrative responsibility for some specified functions to lower levels within the central government bureaucracy. Delegation involves the transfer of managerial responsibility for specified functions to other public organizations outside normal central government control. Devolution is the transfer of governance responsibility for specified functions to local levels that are largely outside the direct control of the central government.

communities facilitates the decision-making processes collectively in a fair, transparent, and prompt way, although many forest users committees lack such governance issues. Local communities are pluralistic in nature and their traditional norms, rules, and regulations check the overexploitation of the natural resource base to maintain the sustainability of forest production. Decentralization leads to an increase in efficiency of resource management by implementing policies and programs that reflect people's real needs and preferences, and enhances accountability and monitoring of decision-makers (Anderson 2000, 2006; Chatterji 2001; Dabire 2003; Jutting et al. 2004). Decentralized forest governance has been adopted as a key strategy of ensuring efficiency, equity, and democracy in the forest governance system and transfers the authority and management functions related to forest resources from central to local governments (Tacconi 2007; Prassad 2013).

Within the area of natural resource management, governance is essentially a devolutionary process which deals with the transfer of government powers, functions, and skills in the area of natural resource management to local authorities such as local groups, organizations that are part of civil society and local populations (Ostrom 1990; Plumptre and Graham 1999; DFID 2001; Dabire 2003; Graham et al. 2003; Andersson 2004, 2006). Effective governance is central to improved forest cover and change outcomes as well as improves rural and forest-dependent livelihoods (Agrawal et al. 2008; Hajjar et al. 2012; Kumar et al. 2015). The successful, decentralized conservation programs have benefits including effective management, better acceptance of management actions, improved environmental and social understanding, improved trust between stakeholders, reduced costs for enforcement, and increased public awareness (Pinkerton 1989; Borrini-Feyerabend 1996; Inoue and Shivakoti 2015). An important challenge for governance is in ensuring that a supportive environment for sustainable livelihoods is developed at all levels where decision-making takes place, and this is supported by the notion of multi-level forest governance (Inoue and Shivakoti 2015).

Decentralized forest management has been advocated as a policy initiative to improve forest resource conservation and as a key to alleviating poverty and improving the socioeconomic well-being of rural people in developing countries (Agrawal et al. 2008; Larson and Soto 2008; Coulibaly-Lingani et al. 2011; Moorman et al. 2013; Kumar et al. 2015). During the 1980s and onwards, many developing countries experienced various forms of decentralized forest governance with varying degrees of success and failures. The community-based forest management (CBFM) programs, popularly known as community forestry, social forestry, participatory forestry, joint forest management, etc., have been promoted in many countries as an innovative and potential approach to improved forest management and conservation strategies with a comprehensive blend of ecological and socioeconomic objectives (Bowler et al. 2012; Maryudi et al. 2012; Moorman et al. 2013; Baynesa et al. 2015; Chomba et al. 2015; Dressler et al. 2015; Kalonga et al. 2015; Moktan et al. 2015; Oji et al. 2015; Schusser et al. 2015). Many countries have now developed, or are in the process of developing, changes to national policies and legislation that institutionalize CBFM (Schreckenberg and Luttrell 2009).

1.2 The CBFM: Meaning, Attributes, and Extent

The CBFM can be understood as government-approved form of forestry practices involving direct forest users in common decision-making processes and implementation of forestry activities, and as such it requires decision-making autonomy to the direct forest users in setting objectives, local control in forest management and utilization, and ownership of the benefits of the forest (Bowler et al. 2012; Maryudi et al. 2012; Baynesa et al. 2015). It can be considered a state-community forest management strategy aiming to improve livelihoods of forest user, reduce poverty, conserve natural resources, and promote good governance and decentralization (Berkes 1995; Blaikie 2006; DANIDA 2007; Schusser et al. 2013; Kalonga et al. 2015; Moktan et al. 2015; Rahut et al. 2015). It has been meant as a tool for people-centered approach to forest governance and as an efficient strategy to achieve the multiple goals of sustainable forest resource management and poverty alleviation (Agrawal 2007; Beauchamp and Ingram 2011; Moktan et al. 2015).

The CBFM offers an alternative approach for achieving forest sustainability by integrating the knowledge and professional skills of foresters with the knowledge and resources of the local community (Pagdee et al. 2006). The CBFM entails a power shift from government to the local people that influence decisions related to the management of forests, the rules of access, and the disposition of products (McDermott and Schreckenberg 2009). It involves the people living closest to the resource in the design, implementation, and monitoring of management measures, and it can be an important tool for achieving integrated management, moving beyond the limitations of particular sectoral interests and the focus on single species and their habitats (Kearney et al. 2007; Danks 2009). The CBFM strategy of forest management empowered local communities through enhancing their capabilities in efficient management of forest resources. As claimed by the scholar (Sen 1984, 2013), this capability to manage resources thereby improving the standard of living is essential for sustainable well-being of the communities.

The CBFM came into use in the 1970s, and since then, it has been a popular policy intervention across Asia, Africa, and, more recently, Latin America (Agrawal 2007; McDermott 2009; Cronkleton et al. 2013; Schusser et al. 2015). It is no longer limited to a few pilot projects and remote places, but it has found recognition in mainstream development (Sikor 2006). Around one quarter of forests in developing countries is now under the control of local people (White and Martin 2002). It was estimated that over a tenth of the world's forests were managed accordingly to models of community forestry (Bull and White 2002; Casse and Milhoj 2011). Based on global forest resources assessment report of 2015, Gilmour (2016) reported that about 18 % of globe's forest areas are under community management (Fig. 1.1). Globally, the CBFM tends to be situated where people are impoverished or without options and, often, forest health is poor (McDermott and Schreckenberg 2009). While twenty years ago it was hard to imagine a substantial

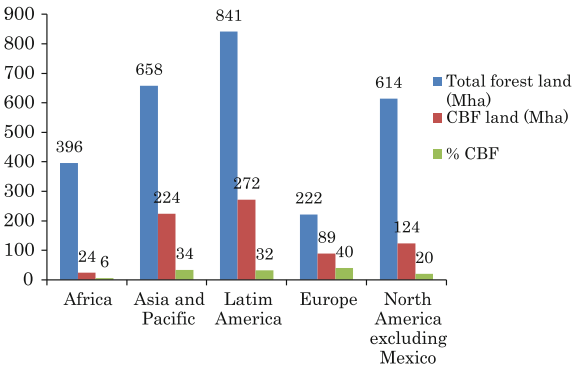

Fig. 1.1 Area of forest under CBF regimes, by region (Gilmour 2016)

community role in forest management in Asia-Pacific region, local engagement in forest management is becoming steadily established through schemes such as forest land allocation and other modes of participatory forest management (Mahanty et al. 2009).

A review of community-based forest management in Asia and the Pacific regions (Table 1.2) showed that in some countries, positive initiatives have been taken by local and national governments to promote a community-based approach (Colchester 1994; Gilmour 2016). Noticeable changes in forest management took place in South and Southeast Asia during the early 1990s when new forest policies

Table 1.2 Extent of CBFM in Asia and the Pacific (Gilmour 2016)

Country	Forest land (Mha)	Forest under CBFM (Mha)	% of forest land under CBFM
Australia	123.00	41.90	34
Bangladesh	2.52	0.27	11
Bhutan	3.10	0.04	1
Cambodia	11.12	0.25	2
China	181.38	108.91	60
India	68.43	23.20	34
Indonesia	131.20	0.84	1
Lao PDR	18.68	5.90	32
Malaysia	18.48	n.a.	n.a.
Mongolia	12.55	3.15	25
Myanmar	20.41	0.05	0
Nepal	6.01	1.87	31
Papua New Guinea	25.33	25.08	99
Philippines	18.08	10.96	61
Thailand	17.22	0.54	3
Viet Nam	13.52	3.81	28
Total	548.03	184.87	34

were implemented recognizing decentralization and the empowerment of the local communities as a fundamental instrument for the management and conservation of forest resources (Balooni and Inoue 2007).

In South Asia, Nepal is considered as the pioneer in CBFM. Community Forestry in Nepal has been very progressive and well known over the last three decades as an institutional innovation that enabled local users to control and manage forestry resources for the improvement of their livelihoods (Maharjan et al. 2009). Till 2007, the government of Nepal has handed over about 1.6 Mha of forest land (over 25 % of the total forest area) to more than 14000 forest user groups, which comprise nearly 38 % of the total population of the country (GoN 2007 cited by Maharjan et al. 2009). The neighboring country India has also been implementing CBFM in the name of joint forest management (JFM) since 1980s. Currently, there are 84,000 JFM Committees in 27 states, managing 17 Mha of forests (Balooni and Inoue 2009). Like India and Nepal, the government of Bangladesh also put emphasizes on CBFM since the early 1980s and a number of forestry projects have been implemented with the participation of local community having both success and failure in intended project outcomes.

It is also worthwhile to mention that there are many other community initiatives, besides CBFM, taking place around the globe. Collective resource management programs that seek to build trust, develop new norms, and help form groups have become increasingly common, and such programs are variously described by the terms community, participatory, joint, decentralized, and comanagement and have been effective in several sectors including watershed, forest, irrigation, pest, wildlife, fishery, farmers' research, and micro-finance management (Pretty 2003).

1.3 Aims of the Book

Bangladesh forests have experienced deforestation and degradation ever since the British colonial period, which continued into the Pakistan era and was inherited by the independent Bangladesh (Nath 2009). In many South and Southeast Asian countries, the command and control approach to forest management is an upshot of colonial rule which manages forests from a commercial viewpoint, ignoring the needs of the local communities. Unfortunately, the colonial legacy of forest policies and management lingered even after independence, with a resulting loss in overall forest cover (Balloni and Inoue 2007). For the colonial foresters, extracting timber as fast as possible was the single goal of forest management and the interdependence between forests and local people was largely ignored (van Gelder and O'Keefe 1995). Over a 20-year period ending in 1980, the forests cover of Bangladesh declined by 2.1 % annually (FMP 1992). If the forests continue to be depleted at the current rate, the area of forests will be less than 1 Mha by 2050 (Iftekhar 2006). The rapid degradation of the natural forest resource base in Bangladesh worsens rural poverty (Islam et al. 2012).

The major weakness of forest management in Bangladesh has been the inability to secure the participation of villagers and the community at large, which has led to large-scale encroachment and pilferage and this can only be stopped by getting public participation (FMP 1992). The national forest resources and the authority, the forest department (FD), over them have been centralized under government, superseding traditional rights and communal authority (Millat-e-Mustafa et al. 2002). In response to forest degradation, increasing emphasis has been placed, over the last two decades, on social forestry, which provides a new dimension of small-scale, participatory forest management, leveraging local understanding and knowledge for the utilization, protection, and maintenance of forest ecosystems (Muhammed et al. 2008). Recognizing continued degradation and depletion of forest resources and the inadequacy of conventional forest management, the government has been exploring various alternatives (Rana et al. 2007).

Realizing the adverse effect of strict approach of earlier forest management policies and management plans, where people had no involvement, the government has shifted policy focus and management regimes, placing emphasis on CBFM involving forest-dependent communities (Biswas and Choudhury 2007). It is not surprising that in Bangladesh attention has now been focused on how to develop sustainable forest resource management programs that combine forest protection with poverty reduction (Islam et al. 2012). In order to boost and maintain the sustainability of various forms of CBFM activities in the country, the government has taken up several measures. The current national forest policy that was formulated in 1994 emphasized the importance of increasing the country's forest coverage by 20 % by 2015, by involving local people in plantation development programs with appropriate benefit sharing.

The CBFM activities in Bangladesh include several types of forest management approaches such as social forestry, community forestry, participatory forestry, co-management of forest protected areas, communal forest management. There have been a number of individual studies on different aspects of CBFM in Bangladesh. Among them, some scholars analyzed policy processes (Alam 2009; Biswas and Choudhury 2007; Chowdhury et al. 2009; Muhammed et al. 2005, 2008), participation in forest management (Khan and Begum 1997; Salam et al. 2006; Nath and Inoue 2008a; Islam et al. 2012), and forest conservation and livelihoods of participants (Safa 2004; Nath and Inoue 2008b, 2009, 2010; Chowdhury and Koike 2010; Mukul et al. 2010; Islam et al. 2012; Islam and Sato 2012, 2013; Jashimuddin and Inoue 2012; Chowdhury et al. 2013).

In this book, we aim to shed light on evolution of CBFM in Bangladesh and critically evaluate the performance of various CBFM practices. Stress is given on how to sustain the CBFM and integrate these into (i) carbon forestry projects (e.g., REDD+) for meeting the triple benefits of forest management: poverty reduction, forest conservation, and climate change mitigation; (ii) mutual rotating fund for creating alternative income generation opportunities so that dependency on forests is reduced, and (iii) corporate social responsibility activities of corporate agencies so that they provide funding for environmental conservation and social development. These strategies might facilitate sustainability of CBFM in Bangladesh. So

far our knowledge goes, there is no such book publication available in Bangladesh. Therefore, we believe that this publication would fill this gap and be useful for researchers, professionals, policy makers, and students as a reference book.

1.4 Outline of the Book

The book consists of seven chapters including this introductory in this chapter (Fig. 1.2). Chapter 2 describes the evolution of CBFM in Bangladesh. Although Bangladesh forest has a history of more than 100 years of scientific forest management since the British colonial period, but the CBFM is a recent intervention. In this chapter, we analyze the salient features of forest policies and how policies had been changed toward the CBFM. The various components of CBFM initiated by various agencies and their achievements are portrayed.

This book describes four case studies of which two (Chaps. 3 and 4) have been carried out in plain land areas where mainstream people are involved with forest management and the remaining two case studies (Chaps. 5 and 6) were conducted in the Chittagong Hill Tracts where indigenous/tribal people are involved. The Betagi–Pomra Community Forestry (CF) is considered as the first successful CBFM initiatives in Bangladesh implemented by the forest department (FD). In Chap. 3, we show the situation of Betagi–Pomra CF after 35 years of inception. The present forest conditions (stock, growth, etc.) and livelihoods of the participants, and potential threats are described. Even though forest conditions seem reasonably good and livelihoods of the participants had improved greatly, but problems are

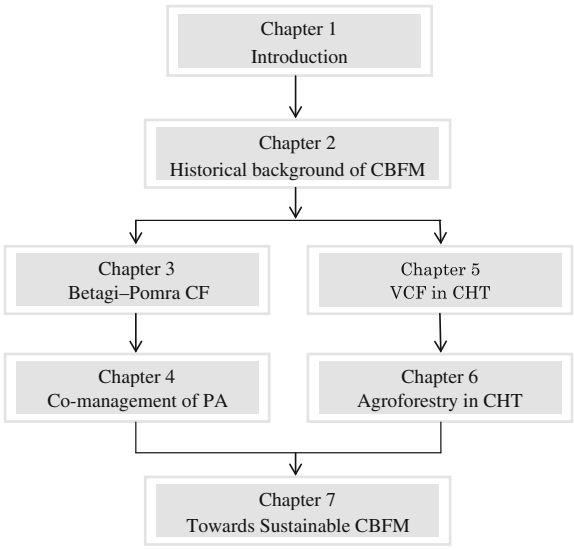

Fig. 1.2 Schematic outline of the book

remaining with land tenure and fragmentation of forest land which might put serious threat on sustainability.

Chapter 4 discusses comanagement of forest protected area management, a very recent CBFM intervention in Bangladesh being implemented by the FD. Drawing on empirical data from Chunati Wildlife Sanctuary, this chapter examines the effectiveness of comanagement on forest conservation and on livelihoods of forest-dependent local people. To some extend, the approach was able to arrest forest degradation, but heavy dependency of local people on forest resources for their living imposes challenges on conservation of forest resources. Land tenure and land use conflicts are other potential threats that jeopardize the achievement of comanagement.

Hill forests that are located mostly in the Chittagong Hill Tracts (CHT) represent nearly 50 % of natural subtropical forests of Bangladesh. However, due to continuous illegal logging and deforestation these forests lost their original legacy. In the face of forests loss, the indigenous communities of the CHT have been conserving a patch of forest, known as village common forest (VCF), near to their locality as a measure of biodiversity conservation. In Chap. 5, we explore the indigenous management of VCF, biodiversity situation and dependency of community people on the VCF. The population pressure, land tenure problem, and intrusion of market economy have imposed threats on the VCF.

Promotion of agroforestry has been widely suggested for reducing the degradation of forests. In Chap. 6, we look at opportunities and challenges of agroforestry development through participation of indigenous communities in the CHT. The data for this chapter were drawn from an agroforestry project implemented by scholars of a university. The project authority adopted a holistic participatory approach that aimed to create social capital (trust) in participants and with financial and material supports they would develop their own agroforestry. While many participants followed instructions of project authority, some of them were reluctant due to their inclination to long tradition.

Chapter 7 is the final chapter of this book, draws a comprehensive discussion by comparing Chap. 3 through Chap. 6. Individual ownership, users' management rights, well-defined boundary, small resource system, social equality ensures relatively more sustainable management of forests in Betagi–Pomra CF, VCF, and AF projects than that of Chunati PA. Some policy implications are suggested for sustainability of various CBFM approaches, and recommendations are made to incorporate REDD+ schemes, introducing mutual rotating fund and collaboration of corporate agencies in CBFM.

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Chapter 2
The CBFM in Bangladesh: A Historical Background

This chapter describes the evolution of CBFM in Bangladesh. Although Bangladesh forest has a history of more than 100 years of scientific forest management, CBFM is a recent intervention. In Bangladesh, this approach has been evolved from a policy emphasis over commercial production toward a more people-centric model designed to support the conservation of forest resources. First introduced in the late 1970s, community forestry, a form of CBFM, has proven a successful model for reforestation, afforestation, and diversifying economic opportunities in rural communities. The 1994 Forest Policy, the Forest (Amendment) Act of 2000, and the 2004 Social Forestry Rules are considered milestone achievements for the implementation of CBFM in Bangladesh. The CBFM has succeeded in reducing distrust and conflict between forestry officials and local people, encroachment on forest lands, and the deforestation rate. But, program implementation has faced roadblocks that stem from a top-down bureaucratic approach and poor governance system.

2.1 Introduction

Bangladesh is a small (147570 km^2) South Asian country that borders India on the west, north, and northeast, Myanmar on the southeast, and the Bay of Bengal on the south. It lies between 20°34′ and 26°38′ north latitude and 88°01′ and 92°41′ east longitude. The country is characterized by a minimal natural resource base and high incidence of natural disasters, including cyclones, floods, and droughts. Forests in Bangladesh are deteriorating at an alarming rate because of various socioeconomic threats, biotic pressure, and competing land uses. Major problems that affect natural resource management in Bangladesh include high economic and spatial incidence of poverty, a high population growth rate, scarce financial resources, inappropriate application of technologies, institutional weakness, poor human resources, poor quality of data about the resource, and declining productivity and sustainability of forest resources (FAO 2000). While forests have always played an important role in

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human history, their rational management became a key social concern in the 1980s in both developed and developing countries (Biswas 1992). Faced with increasing rates of deforestation, and the attendant problems of loss of biodiversity and other socioenvironmental costs, the issue of conservation and rational management of forests became an important item on the agenda of many national and international organizations. In recent years, forest management practices have shifted from an emphasis on maximizing yield to maximizing sustainability through increased participation of local forest communities, conserving biodiversity, and maintaining forest-based ecosystem services (BFD 2011).

To address the degradation of tropical forests, policy and management regimes have been revised to reflect the change from centralized government management toward more participatory management systems (Biswas and Choudhury 2007). A key drawback of the centralized management system is lack of ownership over forest resources, which often results in illegal cutting, forest encroachment, etc. Thus, participatory forestry has evolved with the broad aim of giving forest-dependent people ownership and a stake in managing forest resources, so they have an incentive to protect the resource. Though these efforts have produced some promising results, many have failed to provide local people meaningful and enduring involvement; thus, such efforts often collapse once the program ends. Participants naturally expect genuine involvement, as opposed to a purely "ceremonial" role in the management process. Effective participatory forestry efforts must also include short-term income-generating activities because traditional forest management activities often require long rotation periods before there is no return on an investment.

2.2 Forests of Bangladesh

Bangladesh has only 2.52 Mha (million hectare), 17 % of total land designated as forests (BFD 2011), although FAO (2011) estimates 1.44 Mha (11 %) as effective forest cover. The per-capita forest area in Bangladesh is very low (0.009 ha) compared to average values in Asia (0.145 ha) and the world (0.597 ha) (Jashimuddin and Inoue 2012). Distribution of forests in the country is considerably skewed, with 29 out of 64 districts having no official forest area at all and only 12 with an area of 10 % or more (Jashimuddin 2011). Deforestation rates around the world show signs of decreasing, but are still alarmingly high at an average of 5.211 Mha (0.1 %) per year (FAO 2010). Bangladesh has also shown some positive progress reducing the rate of annual deforestation from 2.1 % during 1960–1980 (Chowdhury 2003) to about 0.2 % between 1990 and 2010 (FAO 2011). Looking at public forestland in Bangladesh, about 15 % can be considered as closed canopy (more than 40 % crown density), 19 % is open forest (10–40 % crown density), 12 % is plantation, and the remaining 54 % is used for non-forestry purposes (FAO 2000). The growing stock of forests in Bangladesh is also low (48 m^3 ha^{-1}) compared to average values in South and Southeast Asia (99 m^3 ha^{-1}) and the world (131 m^3 ha^{-1}) (FAO 2010). There is also a big gap between the supply and demand of wood in Bangladesh,

which has been forecasted to increase by 2020 (FAO 2000). The forest sector's contribution to GDP is underestimated at 5 % because this figure does not include the value of fuelwood and other minor forest products used by rural people or the role of forests in harboring biodiversity, buffering watersheds that supply irrigation and hydraulic infrastructure, protecting coastal areas from natural disasters, and surrounding environment from pollution (BFD 2011).

2.3 Forest Management: Law and Policy

The history of forestry in Bangladesh can be characterized as a classic example of continued deforestation and degradation. The forests were exploited to earn revenue and supply raw materials for the ship and rail industries during the British colonial era (1757–1947) and generate revenue and supply raw materials for forest industries during the period of Pakistan's rule (1947–1971), which also continued into the current period of independent Bangladesh sovereignty (Iftekhar 2006). The conventional central forest management system in Bangladesh has been deemed unsuitable for the resource base and the country's socioeconomic situation. Because of an inability to prevent widespread overexploitation of forest resources, many state forest areas have been rapidly degraded under population pressure and increasing demands for forest products (Biswas and Choudhury 2007). That said, the forests of Bangladesh have been under planned management—that includes formal polices and laws—for more than a century.

Scientific forest management started with the establishment of the Imperial forest department in 1864 during British colonial period (BFD 2011). The forest department (FD) initiated plantation programs since 1871 with first teak plantation at Sitapahar in Chittagong Hill Tracts. Forests in hilly terrain were initially managed on a care and maintenance basis, while the lowland *Sal* forests came under the Department's jurisdiction during the 1950s (FAO 2000). Forest management plans were prepared for each management division. These plans guided managers' day-to-day activities, outlining where trees should be cut, how many should be cut, and what should be replanted on an annual basis (BFD 2011). The first working plan was implemented in the Sundarbans in 1893. In those days, forests were managed primarily for revenue collection under control of the Revenue Department. Thus, the forest department focused mainly on the extraction and replanting of valuable trees without considering local people needs or their participation in managing forests (Hossain 1998).

Although traditional forest management techniques included both economic and ecological objectives, Bangladesh experienced rapid deforestation because of various socioeconomic and sociopolitical factors (Muhammed et al. 2005). These factors have minimized the utility and use of traditional forest planning and management. Unplanned and unforeseen human pressures have exceeded planned conservation efforts, leading to widespread deforestation and fragmentation of forest resources (FAO 2000). Dense population and limited land area compelled

policymakers to consider alternative management practices. One such alternative, social forestry was introduced in Bangladesh in the late 1970s and has proven to be successful. The forest department has shifted its role from custodian to a more participatory model that includes local people in forest protection and reforestation activities, as well as a benefit-sharing mechanism (BFD 2011). At the same time, development objectives at the national level have come to focus on forestry as a means for positively impacting social, economic, and environmental conditions, further underscoring the need for a socially oriented system of forest management.

2.3.1 Forest Law and Policy

The first forest law on the Indian subcontinent was enacted by British colonial rulers in 1865 which was subsequently amended in 1878 and in 1927. In Bangladesh, period after being independence in 1971, the Forest Act was first amended in 1989 to strengthen forest protection by providing stiffer penalties and restricting the discretionary powers of forest officials and local magistrates. This amendment increased traditional forest protection measures without introducing social forestry. It was not until 2000, when another amendment was introduced, that the concept of social forestry began to take shape (Alam 2009). The Forest (Amendment) Act of 2000, under which the government formulated the landmark 2004 Social Forestry Rules (SFR), is considered a milestone for the implementation of community forestry in Bangladesh. The SFR were subsequently amended in 2010 to support more equality in participant selection criteria—opening the process to women and the poor—and increasing benefit sharing by adjusting Participatory Benefit Sharing Agreements (PBSA).

The formulation of a forest policy in Bangladesh dates back to the colonial period of British rule, with the first forest policy being enacted in 1894 and subsequent modifications in 1955, 1962, 1979, and later in 1994. Throughout the British colonial era, forest policy was oriented toward revenue generation and maximum resource exploitation. Forest policy established under Pakistani rule (in 1955 and 1962) showed a high degree of continuity with its colonial heritage and maintained an emphasis on commercial and industrial interests. This trend continued even after independence of Bangladesh in 1971, with limited revenue collection and industrial use, and imposing ban on timber extraction in selected forest types. The first national forest policy of Bangladesh was enacted in 1979. This policy clearly established a participatory approach for the management of government-owned forestland and plantations on marginal lands (Muhammed et al. 2005). It also paved the way for social forestry in Bangladesh, but failed to effectively address the issue of broader participation in forest management (Millat-e-Mostafa 2002).

Negative social impacts from years of excessive government-sponsored commercialization of forest interests include the systematic alienation of local communities, disregard for local economic and subsistence needs, and the progressive

diminution of traditional rights. However, the current forest policy formulated in 1994 represents a significant move toward people-oriented forestry and demonstrates the government's determination to protect and develop forest resources through popular participation. In an effort to better integrate community forestry into forest management practices, the government also formulated the 2004 Social Forestry Rules. These policy reforms have (i) increased opportunities for local communities to participate in forestry activities and share experiences with the FD, (ii) changed FD officials' attitude toward the participation of local communities in forestry activities, (iii) made people more aware of and confident in the FD, (iv) made it possible to involve the poorer sectors of society in forestry activities, thereby contributing to poverty reduction, (v) increased the transparency of the FD's operations, and (vi) created a social forestry wing and new technical positions within the FD's operating budget. However, additional reforms are urgently needed to further increase the efficiency of the FD and improve its governance capabilities (ADB 2007).

2.4 The CBFM in Bangladesh

The community-based forest management, popularly known as community forestry (CF), social forestry (SF), participatory forestry (PF), or agroforestry (AF), has been practiced in Bangladesh for more than three decades. The SF programs have been initiated to meet local populations' forest product needs, reverse ecological degradation, and improve the socioeconomic condition of rural populations (BFD 2011). Such programs have become highly attractive and acceptable to many rural people, especially the landless and small farmers. The basic principle is integration of local people in reforestation activities with multiple objectives that include ecological, economic, and social benefits (Ahmed and Akhtaruzzaman 2010). Community forestry has generated sufficient resources and income to raise the rural poor above-subsistence levels and proven that it can play a significant role in rural poverty alleviation in Bangladesh (Zashimuddin 2004). Apart from making resources available and generating employment and income, community forestry is also playing a vital role in conserving the environment.

The forest policies that institutionalize the CBFM in Bangladesh are considered to be the most elaborate in the country's history. However, progress remains slow because inadequate institutional support, political instability, and poor governance hinder policy and program implementation (Muhammed et al. 2008). Khan and Begum (1997) showed that participatory forestry in Bangladesh has reduced distrust and conflict between forestry officials and local farmers, encroachment on government lands, and rates of deforestation. In CBFM programs, locals are involved in tree plantation activities, while unauthorized settlers have been given usufruct rights in designated forest areas through benefit-sharing agreements (BFD 2005). Participation in resettlement programs has increased household incomes, employment opportunities, and financial and non-land assets. Safa (2004) found

that participatory management regimes contribute to sustainability and improve settlers' standard of living, suggesting it is an efficient management option for sustainable forest management in Bangladesh.

The CBFM is not a very old concept in principle, but indigenous and other forest-dependent communities have shown remarkable success in managing forest resources for centuries in Bangladesh and other parts of the world. The Village Common Forests (VCF) managed by indigenous communities in the Chittagong Hill Tracts (CHT) is one such example of sustainable forest management. Community forestry projects in Bangladesh can be classified into three categories based on who initiated the program—the government, an NGO, or the local community. Regardless of the initiating organization, these initiatives are unique and have their own stories of success or failure that depend on management practices and local conditions.

The Bangladeshi government—primarily through its forest department—has sponsored several initiatives to involve communities in conserving state-owned forest reserves (especially in *Sal* and hill forest areas), unclassified state forests (hill forest areas owned by district administration), mangrove forests (Sundarbans and coastal areas), and marginal lands (roadsides, railways, canal embankments, etc.). It is estimated that there are about 4.65 Mha (which is about 31 % of the country's total area) of land available for social forestry in Bangladesh (BFD 2011). The first attempt at community forestry in Bangladesh can be traced back to the Betagi and Pomra community forestry projects in 1979 and 1980, respectively, in the Rangunia subdistrict of Chittagong (Zashimuddin 2004; Islam 1998). There is also evidence that the *taungya* system, derived from the Burmese terms for hill cultivation—*taung* means hill and *ya* means cultivation (Poffenberger 2000), was introduced much earlier in the CHT by the forest department. This program encouraged the hill people to produce crops and trees at the same time in an attempt to improve traditional shifting cultivation and settle the cultivators, who were also involved in some of the first teak (*Tectona grandis*) plantations as early as 1871 (Table 2.1).

Forest extension activities were also launched in 1962–1963 with the establishment of two forest extension divisions—first at Dhaka and Rajshahi, and later at Comilla and Jessore. Extension activities were primarily confined to establishing nurseries in the district headquarters to raise and sell seedlings to individuals and organizations in urban areas. Since 1982, the forest department has successfully implemented some CBFM programs and others are in development (Table 2.1). While traditional forest management resulted in a net loss of forest cover, social forestry is playing a vital role in the expansion of forest cover while benefiting thousands of poor people (Muhammed et al. 2005).

2.4.1 Components of the CBFM

Key components of CBFM projects implemented in Bangladesh include establishment of woodlot plantations, agroforestry plantations, strip plantations along roads, railways, and canal embankments, rehabilitation of landless farmers in the

Table 2.1 Historical development of CBFM programs in Bangladesh (*Source* Jashimuddin and Inoue 2012)

	Programs	Period
1	*Taungya* System	1871
2	Forestry Extension Service Phase I	1962–1963
3	Betagi-Pomra Community Forestry Project	1979–1980
4	Jhumia Rehabilitation Programme in CHT Phase I	1979–1989
5	Development of Forestry Extension Service Phase II	1980–1985
6	Community Forestry Project	1982–1987
7	Thana Afforestation and Nursery Development Project	1987–1995
8	Jhumia Rehabilitation Programme in CHT Phase II	1990–1995
9	Participatory Social Afforestation	1991–1998
10	Forest Resources Management Project: Forest Directorate Component	1992–2001
11	Extended Social Forestry Project	1995–1997
12	Coastal Greenbelt Project	1995–2000
13	Forestry Sector Project	1997–2004
14	Sundarbans Biodiversity Conservation Project	1999–2006
15	Nishorgo Support Project	1999–2008
16	Integrated protected area co-management	2004–2013
17	Char Development and Settlement Project-III (2nd Phase)	2005–2010
18	Reedland Integrated Social Forestry Project	2005–2010
19	Afforestation in the Denuded Hill Areas of Chittagong North Forest Division (2nd Phase)	2008–2012
20	Biodiversity Conservation and Poverty Alleviation Through Afforestation in the Greater Rajshahi and Kushtia Districts	2008–2012
21	Participatory Social and Extension Forestry in Chittagong Hill Tracts	2008–2012
22	Community-Based Adaptation to Climate Change through Coastal Afforestation	2009–2012
23	Re-vegetation of Madhupur Forests through Rehabilitation of Forest Depended Local and Ethnic Communities	2010–2012
24	Poverty Alleviation through Social Forestry	2010–2013
25	Management of Natural Resources and CF in Chunati Wildlife Sanctuary	2009–2015

Chittagong district and shifting cultivators in the Chittagong Hill Tracts, village reforestation, institutional planting and seedling distribution, establishment of nurseries and training centers, establishment of a plantation center, and training of various stakeholders involved in the program. Major objectives of these projects include increasing timber production, poverty reduction, and enhancing the forest department's institutional capacity. Forest-dependent local people and indigenous communities are the major stakeholders in these programs. Participatory projects generally grant each single participant one hectare for management as a woodlot, every five participants one kilometer of strip plantation, and each family two hectares for settlement and agroforestry. Participants are allowed to grow fruit and

other crops between trees, participate in wage labor for plantation maintenance, and retain intermediate products from thinning and other forest management activities.

Experience gained from the CBFM programs in Bangladesh has helped policy-makers accommodate technical problems faced during the implementation of different projects. For example, the SFR, through Participatory Benefit Sharing Agreements (PBSA) (Table 2.2), provided program participants with the legal right to participate in plantation activities sponsored by the FD and then claim their due share of the benefits after harvest. Compliance with the SFR, particularly in signing the PBSA and providing copies to group members, seemed generally satisfactory, though in some cases certain "formalities" took an unusually long time to complete

Table 2.2 Participatory Benefit Sharing Agreements (PBSA) under SFR 2004 (*Source* BFD 2011)

	Type	Stakeholder	Share of benefit (%)
A	Woodlot and agroforestry in forest areas	Forest department	45
		Beneficiaries	45
		Tree Farming Fund	10
B	*Sal* forest conservation and development	Forest department	65
		Beneficiaries	25
		Tree Farming Fund	10
C	Strip plantation in the private or public lands other than forest department-owned lands	Forest department	10
		Land owning agency	20
		Beneficiaries	55
		Local Union Parishad	5
		Tree Farming Fund	10
D	Char land and foreshore plantation	Forest department	25
		Beneficiaries	45
		Land owner or tenant	20
		Tree Farming Fund	10
E	*Khari* (natural canal or ditch) and pond bank rehabilitation and plantation in Barind Tracts	Forest department	25
		Beneficiaries	45
		Land owner or tenant	20
		Tree Farming Fund	10
F	Plantations and natural forests except *Sal* forests	Forest department	50
		Beneficiaries	40
		Tree Farming Fund	10
G	Social forestry in the forest department-owned lands initiated by local people	Forest department	25
		Beneficiaries	75
H	Social forestry in the government, semi-government, or autonomous organization lands initiated by local people	Forest department	10
		Beneficiaries	75
		Land owning agency	15

(ADB 2007). Many believe participatory forestry cannot be sustained on government and grant money alone; the Tree Farming Fund (TFF) has been established to reduce dependency on government and grant money. The TFF is intended to cover 50 % of replanting costs, with the remaining 50 % covered by project revenue. If the TFF is unable to cover its share of the replanting cost, participants are asked to contribute volunteer labor to cover the shortfall. This combination of TFF funds and participatory labor is intended to make participatory forestry more sustainable (BFD 2011).

2.5 Making CBFM Work

The CBFM in Bangladesh has achieved notable success in terms of funds allocated for afforestation, though there is a significant controversy over the effectiveness of these programs to achieve the desired outcomes. For example, the Integrated Protected Area Co-management (IPAC) project supported by USAID (United States Assistance for International Development) in Dudhpukuria has made significant inroads protecting the forest from illegal logging through regular community forest patrols via a partnership between the FD and local community (NSP 2011). According to Islam (1998), the Betagi–Pomra community forestry model has provided employment opportunities, encouraged afforestation and more efficient cropping patterns, helped transform illegal settlers into forest stewards, opened access to more efficient market mechanisms, built community capacity and resiliency, encouraged social equity, and decreased crime, among other positive benefits. Boykoff (2011) has documented a positive impact on local peoples' understanding of forest management—quoting one community member, "If there are trees in the forest this will help our community."

Community forestry has successfully contributed to the establishment of participatory forest resource generation and management, in the process garnering much interest among local community participants. Project activities have significantly contributed to improving relations between the FD and local communities living in and around forest areas. Local communities' confidence in the FD has increased, and they have a positive view of FD participation in plantation activities. CF projects have created beneficial opportunities for the rural poor living in and around plantation sites, especially disadvantaged women who have an opportunity to earn substantial income.

Since the mid-1980s, a total of 30,666 ha of woodlot plantations, 8778 ha of agroforestry plantations, and 48,420 km of strip plantations have been established by the forest department under the community forestry programs (Table 2.3). Approximately 19,790 ha of woodlot and agroforestry plantations, as well as 8,566 km of strip plantations, have been harvested, distributing about US$18.91 million among 85,900 beneficiaries. That equates to approximately US$220 per participant, as well as contributions of nearly US$4.17 million to the TFF (BFD 2011). Safa (2004) also argued that participatory management has had positive impact on peoples' livelihoods and the sustainability of forest resources.

Table 2.3 The CBFM project achievements since the mid-1980s in Bangladesh (*Source* Muhammed et al. 2005)

Components	Achievement
Strip plantations	48420 km
Woodlot plantation	30666 ha
Agroforestry plantation	7738 ha
Embankment plantation	1338 ha
Foreshore plantation	645 ha
Village afforestation	7,421 villages
Seedling for sale and distribution	201 million

Experiences from Bangladesh show that community involvement in forest development and management has increased, but communities do not always fully benefit because they often lack the legal recourse to deal with dispute resolution (ADB 2003). Forest officials' attitude toward community-based initiatives is hindering proper implementation of many community forestry programs. A majority of foresters believe local people can receive benefits from the program, but are not competent enough to participate in planning decisions. They also feel that land used for community forestry should remain under government control, that their chief role is to protect forests or produce revenue for the government, and that local people are the primary cause of deforestation (Khan 1998). Forest officials are generally oriented toward traditional forest management and do not accept local people as development partners (Hossain 1998). Generally speaking, foresters feel local community involvement will undermine their legal control over nationalized resources (Poffenberger 2000). Furthermore, widespread corruption and poor governance in the forestry sector (Muhammed et al. 2008) is hindering the progress of social forestry programs.

In addition to eliminated corruption, Miah et al. (2011) suggest greater political will is needed to support community forestry, as well as initiatives that bridge the gap between policy, science, and practice. They also note many regulatory policies and measures are too vague to be of much use, creating loopholes that lead to abuse. In some cases, participatory forestry actually increased deforestation because local people were not meaningfully involved in management, lacked economic alternatives to deforestation activities, and doubted the programs would lead to any long-term economic advantage. Furthermore, some participants secretly sold their allotted plots to local elites, undermining the entire process.

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Chapter 3
Betagi–Pomra Community Forestry (CF): 35 Years of Pioneer CBFM in Bangladesh

It is about 35 years that the Betagi–Pomra CF had been implemented. In this chapter, we investigated the impact of Betagi–Pomra CF on livelihoods of participants by employing DFID's sustainable livelihood framework. Respondents were asked to recall and provide data at the beginning of the project (hereafter BP) and at the time of interview, at present (hereafter AP). A SWOT analysis was conducted, through group discussion, to explore the possible impacts of five livelihood capitals if we suppose to introduce REDD+ activities in these sites. Analysis of BP and AP data shows significant positive changes in all livelihood capitals due to the CF activities. The degraded forests have now been converted into plantations. One of the potential threats that might jeopardize the goals of CF in the project sites is the continuous fragmentation of land. Fragmentation of allocated CF plots due to population growth and division of family seems a serious menace for the sustainability of CF. Regular monitoring by the FD staff members and, if necessary, review of agreement might be helpful to prevent land fragmentation.

3.1 Background and Approach

The Betagi–Pomra CF project in Rangunia Upazila of Chittagong district, Bangladesh, was the first intervention by the forest department (FD) that involved poor landless community people in forest management. It has passed more than 35 years since its inception in 1979. However, there were not many studies we can find on this project. The notable scholarships (based on Google scholar search) include a consultancy report (Quddus et al. 1992), two conference papers (Zashimuddin 2004; Islam 2005), and three research articles (Rahman 1987; Islam 1998; Jashimuddin and Inoue 2012). These studies investigated land use changes, land expectation values, policy implications, and socioeconomic impacts of the CF project. We felt that a study is important to examine the impact of CF project on

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livelihoods of the participants. We followed sustainable livelihood framework (DFID 2001) to study the livelihood impact.

For primary data collection, two preliminary visits were conducted at each research site (or village, Fig. 3.1) during October 2012 to November 2012. Based on the preliminary visits and discussion with the project participants and FD staff members, a survey questionnaire was designed to collect information on the

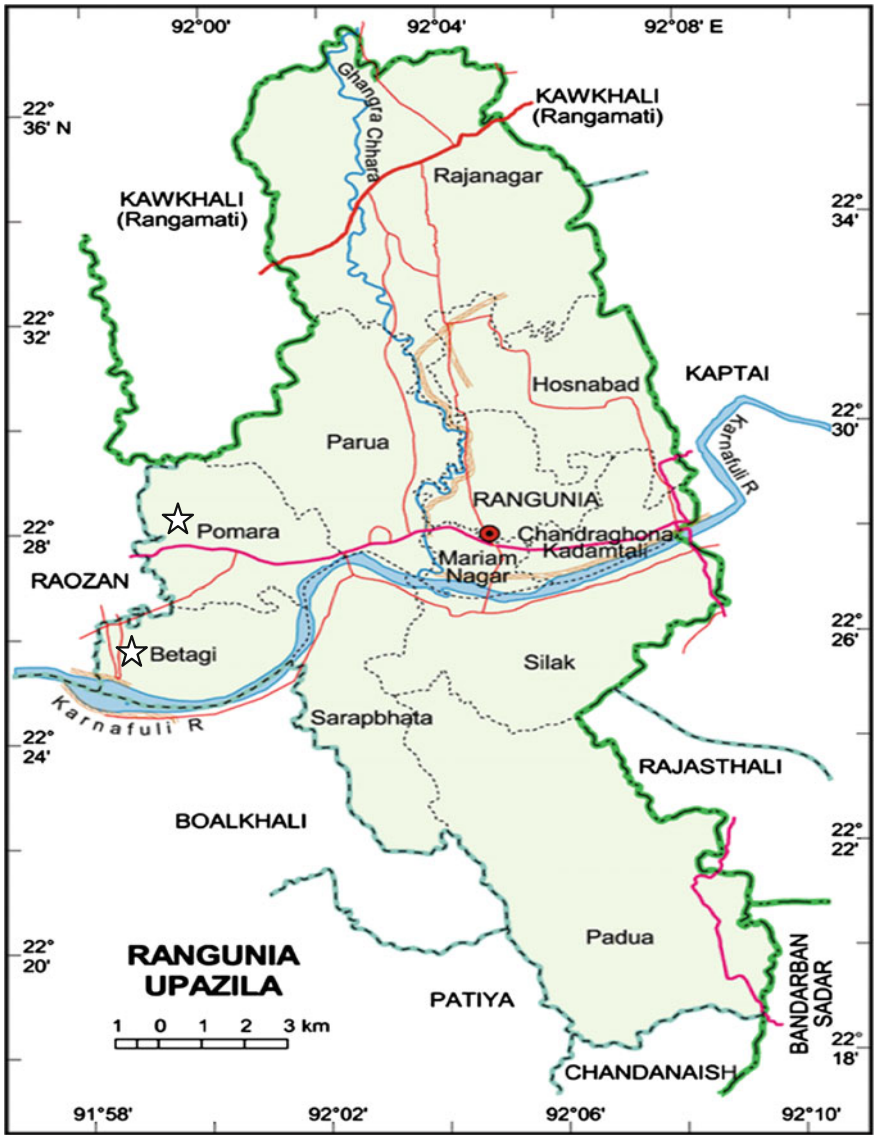

Fig. 3.1 Map of Rangunia Upazila showing the study area (☆)

changes in "livelihood capitals" (or human, social, physical, natural, and financial capitals) during a few decades. Respondents were asked to recall and provide data at the beginning of the project (hereafter BP) and at the time of interview, at present (hereafter AP). Key-informants interviews and group discussion were also held in both project sites which highlighted issues including project history, land use changes, conflicts/problems, and impacts of project on socioeconomy of the participants. Both qualitative and quantitative data were collected. In total 80 participants, 40 from Betagi and 40 from Pomra were selected randomly for the household survey. Vegetation survey was conducted in 50 % of the sampled participants' CF plots. In each selected participant's CF plot, five (05) quadrats (20 m $\times$ 20 m) were laid out. In each quadrat, tree species composition, diameter at breast height (dbh), and total height of all trees were measured. A SWOT (strengths, weakness, opportunities, and threats) analysis was conducted, through group discussion, to explore the possible impacts of five livelihood capitals if we suppose to introduce REDD+ activities in these sites. Data were analyzed both qualitatively and quantitatively. Simple statistical analysis (pair t test) was conducted to explore significant variation of some selected variables between BP and AP.

3.2 Project History: Participants' Recitation

The Betagi–Pomra CF project, popularly known as settlement project, was initiated in 1979–80 financial year. Many local and government officials were involved with the conceptualization of the project. Key-informants commented that a local school teacher "Quddus Master" was the key-person who voluntarily worked hard to initiate the project in the area. He shared his idea of settling local landless/poor people and to rehabilitate degraded forest and government *khas* land (degraded and unused government land) through community participation with Mr. Mahbub Alam Chashi, a national bureaucrat of their locality. When Mr. Chashi became secretary of Shawnirvar (self-reliance) movement in Bangladesh Government, he invited "Quddus Master" to submit his idea of settlement. After long discussion with other stakeholders including Professor Abdul Alim, former Chief Conservator of Forests (CCF), Professor Dr. Younus of Grameen Bank, and official procedural systems, the project was finally approved for implementation in the late 1970s.

In 1979, the project was first implemented in Betagi with 83 participants and in Pomra in 1980 with 253 participants. Each participant were granted four (04) acres (1.62 ha) of degraded land. The land in Betagi was under *Khas* land category administered by district commissioner while in Pomra the land was under protected forest (PF) category under the jurisdiction of the FD. There were two committees worked for the selection of participants—one at local (Union Parishad) and the other one at subdistrict (thana) level. Key-informants said that with a few exceptions the selection of participants was genuine and appropriate persons who fulfilled

the required criteria were selected as participants. The criteria were landless or having a landholding of ≤ 40 decimals, able to work hard and would not work outside, should build house and live within the plot with their family members (although not written in the agreement) or should live within one km of project site, and would follow the instructions of the FD officials. The project officials had to cancel many participants from the project in both sites because these participants did not follow instructions of the FD staff, could not establish plantations, and worked outsides for earning. Key-informants commented that those who had no experience on working in the hills, for example rickshaw puller and boatmen, could not survive in the project. Many participants were in dubious whether government would give them land certificates or not, and therefore, they left the project. The canceled and absentee plots were then reallocated to some new participants. In 1985, the then government acquired land from 15 participants of Betagi for the *Badsha* (the King) of the United Arab Emirates and these participants were relocated to adjacent *khas* lands.

In 1987, the participants of Betagi obtained their land tenure certificates for 99 years with the conditions that they could not transfer tenure rights to their ancestor and could not sell land to others. However, in Pomra they still did not get land tenure certificates, and every year, each participant needs to renew their lease and pay a revenue of BDT 60.00 to the FD. Participants said that because the land is protected forest land it would be difficult and lengthy process to obtain tenure certificate. Being *khas* land, the participants of Betagi obtained the certificates easily and shortly after project inception.

3.2.1 Land Uses in the Project Sites

The land granted to the participants was severely degraded before the inception of the project. The FD planted seedlings several times but due to lack of regular maintenance and grazing by domestic animals, the plantations could not be established. The area was covered with bushes with a few scattered trees growing poorly. Some parts of the land were occupied illegally by few local influential people and they were cultivating agricultural crops.

When project came into operation, participants cleared the land, cultivated agricultural crops such as ginger, turmeric, arum, and seasonal vegetables, and planted horticultural and forest tree species. The ginger was most valuable crop during that period. They preferred crops which had market potential. The project authority provided technical support and for material support Grameen bank and Krishi (agricultural) bank provided soft loan. The amount of loan varied from BDT 5000–10000. In most cases, the loan was provided in kinds, for example planting materials (seed and ginger) and fertilizer. The officials of the FD and banks frequently monitored field activities so that participants would not misuse their loans.

Participants established some nurseries collectively and initially raised eucalyptus (*Eucalyptus* spp.) seedlings for planting. The FD provided training on nursery establishment and management, raising and planting seedlings, and maintenance of plantations. The FD also supplied some seedlings such as lemon (*Citrus limon*), papaya (*Carica papaya*), banana (*Musa* spp.), and other fruit species free of cost.

After a few years, the FD discouraged planting eucalyptus and the participants harvested eucalyptus trees and then planted with kanthal (*Artocarpus heterophyllus*), am (*Mangifera indica*), acacia (*Acacia auriculiformis*), acacia hybrid, mahagoni (*Swietenia macrophylla*), gamar (*Gmelina arborea*), and other locally available species. They also maintained naturally growing trees such as koroi (*Albizia* spp.) and sheori (*Anogeissus acuminata*). Participants reported that squirrels damage bark of acacia species and hence, they become reluctant to plant this species although it grows fast and has market demand for timber.

As trees grown up, most of the hills of the project sites become unsuitable for agricultural crops. Participants cultivate agricultural crops where land is available. Most of the land is under tree covers now. During the study, we found plantations mostly of segun (*Tectona grandis*), gamar (*Gmelina arborea*), mahagoni (*Swietenia macrophylla*), acacia (*Acacia auriculiformis*), chapalish (*Artocarpus chaplasha*), and jarul (*Lagerstroemia speciosa*).

3.2.2 Socioeconomic Changes

Socioeconomic situation of the participants at the time of project inception was very weak. They worked as daily labor, and women worked as wage earner in nearby agricultural fields. Some participants pulled rickshaw, extracted and sold forest products. There were limited job opportunities and they could hardly work for a few days in a month. Some of them took loan from NGOs and ran small businesses.

Very shortly after project implementation, they could earn BDT 30,000–40,000/year/family even from the sale of lemon along with additional income from the sale of other products including sun grass (*Imperata cylindrical*), banana (*Musa* spp.), and ginger (*Zingiber officinale*). Now they can easily earn at least BDT 100,000 from various sources. When they need money to invest in any business such as to buy a CNG (compressed natural gas)-driven taxi or to send a boy in Middle East countries, they can easily manage it by selling some trees. Soon after harvesting trees they replant the area. They commented that more than 80 % participants in both sites are now economically solvent. They do business locally and regionally and practice agriculture, and some of their members work in Middle East countries. Some excerpts of respondents related to socioeconomic impact of the projects stated below are as follows:

> This women's house was built with mud wall and sun grass roof, now after 35 years you can see her brick buildings and one of her boys has been working in a computer shop.

> My father was very poor. We all family members (two brothers, father and mother) worked hard to establish plantations. I have graduated with a bachelor degree and now work in a school as a teacher. We are now quite happy and would like to thank the project authority for their very good initiative.
>
> My father was working in a jute mill. We were two brothers and lived in a small hut. After 7 months of project my father resigned from the job and engaged himself full time in project activities. From the plot's income we became educated, my younger brother now work in United Arab Emirates. We are now two brothers and two sisters. We had six decimal of homestead land. By this time we bought land outside the project and built buildings. Earlier I used to buy agricultural products from project sites and sell in Dhaka (our capital city) to earn extra income, but now working as a first-class contractor. All these were possible due to the CF project.

They also commented that

> Those who are absolutely dependent on project plot's products sometimes, especially at the time of natural disaster, they remain vulnerable. For example, frequent cyclones damage their crops and trees and at that time they need help from outside. As we are protecting our environment, we should have some incentives during these natural calamities.

3.2.3 Conflicts and/or Problems: Then and Now

There were some problems with local influential persons who occupied the land illegally and were not selected as participants. They discouraged participants not to work in the project and created the rumor that the government would acquire the land after several years. They even burnt meeting halls and houses of many participants many times to evict them from the project sites. They also filed cases against the participants for their encroached land, but finally the participants obtained the verdict with the help of the project authority. Key-informants said that not only the influential persons, but also many non-participant neighbors disturbed the participants and damaged their plantations. However, the participants with very active help from project authority collectively tackled all these problems. There were some minor problems like plot boundary demarcation. They, with mutual understanding, resolved these issues by themselves.

The respondents and key-informants in both sites of the project mentioned that absence of electricity is their main problem nowadays. They have been trying for several years but yet to get electricity connection. Although there are three primary schools in and adjacent to Betagi, there is no school in Pomra. A local NGO runs an informal school and the participants said that a primary school is very much needed in their locality. Key-informants reported that active participation of Betagi CF committee and contribution of their participants helped to build a government primary school in their locality. They all very recently contributed BDT 150,000 for the construction of a prayer hall in their village.

3.2.4 Group/Committee Formation and Functions

At the beginning of the project, there were some groups, each consisted of five participants, formed in both the project sites. These groups were formed mainly for lending. However, they also had group saving and helped each other for repayment of loans. Each group hold weekly meeting on Wednesday and discussed what they needed to do for their living. The group functioning was continuing till 1984–85. After that they did not require loan from bank and groups became inactive.

There were two CF committees, each consisting of 21 executive members, in Betagi and Pomra. Key-informants and respondents said that the committee in Betagi was very active and effective because the leader was honest and responsive. All members in their committee actively participated in project functions. There was regular election at two years interval. However, presently the committee in Betagi has become inactive. The reasons they mentioned are that all participants are now solvent, they do not need any support from the FD, they do not have major problems, and they have joined in their social organization formed by all families in the locality including non-participants.

Although there are very limited functions, still there is CF committee in Pomra and looks after social issues such as conflicts among the participants, if any. It maintains liaison with the FD because they do not have land tenure yet. When a participant needs to harvest many trees at a time to meet emergency need, he/she needs permission from the FD. The CF committee helps participants to get such kind of permission. Additionally, the committee coordinates with the FD for the renewal of plot lease and payment of yearly revenue on behalf of the participants.

3.3 Results of Household Survey

3.3.1 Basic Information of the Project Participants and Respondents

In this CF project except three female participants in Betagi, all of them were male. Mean age of the participants was nearly 70 years indicating that household heads were selected as participants. We noticed, during household survey, that about 50 % of the selected participants had died by this time and the living participants are very old. The average household size (household member) was five with a range of 2–20 and more than 50 % of them were illiterate (Table 3.1).

In household surveys, both male and female whoever available at home during survey were interviewed. The mean age of the respondents was about 50 years (Table 3.2) which indicate that they were quite adult at the time of project implementation and they could told us their situation during that period and present time. For children's education, Professor Alim established a primary school at Betagi which was then converted into government primary school (Plate 3.1). Although

Table 3.1 Basic information of project participants in Betagi–Pomra CF project

Variable	Pomra	Betagi
No. of participants	243	83
Gender (%)		
Male	100	97
Female	–	3
Mean age (yrs)	67	69
Present living status (%)		
Deceased	43	50
Alive	57	50
Education (%)		
Illiterate	51	57
Primary	38	27
Secondary	11	16
Family size	5 (2–20)	6 (2–11)

Table 3.2 Basic information of the respondents of household survey

Variable	Pomra	Betagi
Gender of respondents (%)		
Male	27	53
Female	73	47
Mean age (yrs)	53	48
Respondent's education (%)		
Illiterate	46	53
Primary	27	11
Secondary	19	13
College	3	13
University	8	–
Mean family size (No.)	9 (3–27)	12 (4–37)
Male (%)	49	53
Female (%)	51	47
Family types (%)		
Nucleus family	51	70
Joint family	49	30
Age gradation (%)		
Less than 11 years	26	26
11–59 years	66	64
More than 59 years	8	10

some of the participants had primary and secondary education (see Table 3.1), education status had improved overtime, and therefore, some of the respondents had college and even university level education (Table 3.2). Similar trends can also be observed if we see the current school-going students (Table 3.3).

In sampled households, some young boys and girls were studying in colleges and in universities. Respondents commented that they send their sons and daughters

Plate 3.1 Photographs showing CF activities at Betagi and Pomra. **a** A primary school at Betagi. **b** Teak plantations at Betagi CF. **c** Mixed plantation at Betagi CF. **d** Mixed plantation at Pomra CF. **e** Fuel wood stocked at Betagi CF. **f** Tube well at Pomra CF

to universities for higher education which might help to raise their social status and their children would get better job opportunities in future. After 35 years of project, household size had become double (mean size 10) and many of them (more than 50 %) had separated and formed nucleus families (Table 3.2). The difference in household size between beginning of the project (BP) and at present (AP) in both

Table 3.3 Current school-going students in the project sites (values in the parentheses denote percentages)

Variable	Pomra	Betagi
Current school-going students (No.)		
Primary school	19 (61)	15 (52)
High school	7 (23)	10 (34)
College	3 (10)	3 (10)
University	2 (6)	1 (3)
Total	31 (100)	29 (100)
Male	17 (55)	18 (62)
Female	14 (45)	11 (38)

sites was highly significant (Pomra: t = 3.95, Sig. at 0.0001; Betagi: t = 4.20, Sig. at 0.0001). However, at present there was no significant difference in household size between Pomra and Betagi. More than 60 % of total household members in both sites were within 11–59 years of age gradation.

3.3.2 Status of Physical Capital

As we have seen household members were doubled and joint families had been fragmented, number of houses had also increased. We found at present number of houses had increased two and three times in Pomra and Betagi, respectively (Table 3.4) and houses, on an average, now cover about 12.5 decimal area in comparison with 4.5 decimal at the beginning of project (Table 3.4). There was significant difference in number of houses at BP and AP in both sites (Pomra:

Table 3.4 House conditions of the respondents in the study sites

Variable	Pomra		Betagi	
	BP	AP	BP	AP
Mean no. of house	1	1.6	1	2.3
Mean area of house (decimal)	4.9	11.6	3.9	13.1
Housing materials (% of households)				
Wall				
Bamboo	48	5	44	30
Mud	50	82	56	70
Brick	2	8	–	–
Tin	–	5	–	–
Roof				
Straw	27	–	20	–
Sun grass	61	2	60	10
Tin	10	90	20	90
Concrete	2	8	–	
Floor				
Mud	98	92	100	95
Concrete	2	8	–	5

t = 3.54, Sig. at 0.001; Betagi: t = 4.09, Sig. at 0.0001). Similarly, significant difference was observed in the case of house area at BP and AP in both sites (Pomra: t = 2.99, Sig. at 0.006; Betagi: t = 4.20, Sig. at 0.0001). We also found significant difference in house area between two sites at present (t = 2.66, Sig. at 0.01). The majority of the houses are mud-walled. Although roofs of most of the houses were thatched with sun grass and straw at BP, at present 90 % of houses have tin roof and floor of a few houses is made of concrete.

There were no remarkable changes in livestock status among the respondents in both study sites. But in the case of household appliances, we noticed that many of them now possessed expensive and luxury items such as television, sound system, motor cycle, CNG taxi, and tractor, and all of them have mobile phones (Table 3.5). While kerosene was the major source of energy at BP, now some households (13 % in Pomra and 20 % in Betagi) installed solar energy system. For cooking purposes, they still depend on firewood available in their forests. However, 20 % respondents in both sites reported that they use cylinder gas (LPG) for cooking purposes.

At the beginning of the project, the majority of the respondents were using streams and ponds as the main sources of water for drinking and other purposes. We found that at present more than 80 % respondents in both sites possessed personal tube well (Plate 3.1) which they have been using for tapping water for drinking and cooking purposes (Fig. 3.2).

Table 3.5 Livestock status, household appliances, and energy sources of the respondents

Variable	Pomra		Betagi	
	BP	AP	BP	AP
Livestock (mean no.)				
Cow	2	3	3	4
Goat	2	2	2	2
Poultry	10	13	6	14
Household appliances (% of households)				
Television	8	32	–	75
Radio/sound system	3	–	–	49
Bicycle	8	60	10	79
Motor cycle	–	11	–	16
CNG taxi	–	11	–	20
Tractor	–	8	–	7
Mobile	–	100	–	100
Energy sources (% of households)				
Electricity	–	–	–	30
Kerosene	100	87	100	50
Others (Solar energy)	–	13	–	20
Fuel energy of cooking (% of households)				
Firewood	100	100	100	100
Leaves and twigs	70	95	87	93
Cow dung	35	57	63	47
Gas (cylinder)	–	20	–	20

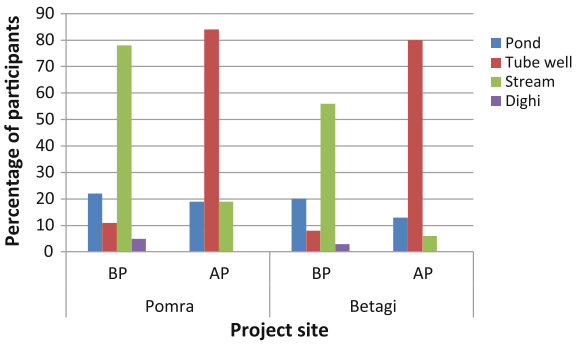

Fig. 3.2 Changes of water sources in the study sites between BP and AP

3.3.3 *Financial Capital: Occupational and Financial Status of the Respondents*

At the beginning of the project, most of the participants were farmer and daily laborer (Table 3.6). A few participants in Pomra were service holder in nearby industries and some of them were carrying out small village business. In Betagi, 10 % participants were rickshaw pullers and 13 % were involved in collection and selling of forest products, mainly of wood. We found that number of daily laborer has dropped to 10–13 %, but number of farmers has increased to around 50 % (Table 3.6). It reveals that participants are now engaged more with their farming practices including agriculture and forest gardening than selling labor to other farms or elsewhere. Few members of some respondents currently work in abroad mainly in Middle East countries and some have bought CNG taxis which they drive by themselves for commuting passengers and earn extra income. On an average, at least three members of a household are now working and earn revenue for their families.

Table 3.6 Occupational status of the respondents

Variable	Pomra		Betagi	
	BP	AP	BP	AP
Occupation (%)				
Farmer	36	46	23	53
Daily labor	36	10	53	13
Business	13	15	–	13
Service	10	15	–	20
Work in abroad	–	8	–	20
Driving	–	8	–	7
Carpentry	5	5	–	7
Wood collector	–	–	13	
Rickshaw puller	–	–	10	3
Mean no. of working person	2.97		3.84	

Table 3.7 Mean annual income (BDT) and income sources of the respondents in the study sites

Variable	Betagi		Pomra	
	BP	AP	BP	AP
Mean annual income	38,146	219,512	28,356	102,239
Sources				
Agriculture	11,438	24,357	3,338	6,458
Daily labor	13,297	9,459	12,853	2,534
Business	3,243	89,432	3,541	17,028
Service	3,080	26,405	4,305	32,004
Livestock	4,60	22,554	8,89	1,285
Forest products	7,088	32,927	4,319	24,280
Foreign remittance	–	14,378	–	18,650
Food security (% of households)				
Surplus	5	62	6	37
Sufficient	31	33	37	46
Shortage	64	5	57	17
Total	100	100	100	100

Respondents recalled their main income sources and how much they could earned from various sources. Based on their estimation, we found a mean annual income of the respondents as BDT 38,146 and BDT 28,356 for Betagi and Pomra, respectively (Table 3.7) at the inception of the project. Of the various sources daily labor, agriculture and homestead forest products contributed highly to the household income. Respondents of both sites reported that at present forest products [timber, fuelwood (Plate 3.1), and fruits], agriculture, service, and foreign remittance provide major portion of household income. If we compare mean annual income at BP and at AP, we find that household income in Betagi has increased 5.75 times while in Pomra it has increased by 3.6 times. The difference between BP and AP was found statistically significant (Pomra: t = 2.73, Sig. at 0.01; Betagi t = 5.25, Sig. at 0.001). The difference in mean annual income between Betagi and Pomra at present was also found significant (t = 2.31, Sig. at 0.02). With this amount of income, 62 % respondents in Betagi and 37 % in Pomra commented that they could manage all of their household expenses and could save some amount of money. Only 5 and 17 % respondents in Betagi and Pomra, respectively, reported to face food shortage while more than 50 % respondents had experienced food shortage at BP.

3.3.4 Natural Capital: Landholding and Forest Conditions

On an average, each respondent had about 20 and 13 decimals of land outside the project site in Pomra and Betagi, respectively (Table 3.8) and total landholding was 419 and 413 decimals including 400 decimals granted by the project at BP.

Table 3.8 Landholding status of the respondents

Variable	Pomra		Betagi	
	BP	AP	BP	AP
Total land (decimal)	419.27	474.78	413.25	468.94
Land (decimal) outside the project site				
Agricultural	15.03	36.51	7.28	12.47
Homestead	4.24	5.84	4.27	5.57
Hilly land	–	32.43	1.70	50.90

Respondents said that with surplus income many of them purchased land from the neighbors. The landholding status shows that each respondent in both sites could accumulate about 55 decimals of land although maximum was hilly land. Although at present there is no significant difference in landholding in two sites, there are significant differences at BP and AP in both the sites (Pomra: t = 3.58, Sig. at 0.001; Betagi: t = 2.11, Sig. at 0.04).

Vegetation study in respondents' plots identified 34 and 21 species in Pomra and Betagi, respectively (Annexes 3.1 and 3.2). Frequency distribution (Table 3.9) of species shows that dominant species in Pomra were gamar (*Gmelina arborea*, 26 %), segun (*Tectona grandis*, 21 %), and kanthal *(Artocarpus heterophyllus*, 15 %) while in Betagi segun (30 %) was dominant followed by mahagoni (*Swientonia macrophylla*, 18 %) and jarul (*Lagerstroemia speciosa*, 11 %) (Plate 3.1). The density of trees was 875/ha and 1453/ha in Pomra and Betagi, respectively (Table 3.9). The density of trees indicates that forests were not well stocked. In general, a well-stock forest should have 2500 trees/ha with a spacing of 2 m × 2 m. Diameter distribution of trees (Fig. 3.3) shows that 92 and 76 % trees in Betagi and Pomra, respectively, were within 10 cm dbh. This means that trees were not very old. Respondents said that they established these plantations 10–12 years ago and hence biomass and basal area growth were low. The basal area was about 5 m^2/ha and aboveground biomass was about 41 tree/ha (Table 3.9).

Table 3.9 Attributes of plantations in the study sites

Variable	Pomra	Betagi
No. of species	35	21
Density (plants/ha)	875	1453
Frequency (%) of dominant species		
Gamar (*Gmelina arborea*)	26	5
Segun (*Tectona grandis*)	21	30
Mahagoni (*Swientonia macrophylla*)	0.5	18
Kanthal (*Swientonia macrophylla*)	15	6
Jarul (*Lagerstroemia speciosa*)	2	11
Minjiri (*Senna siamea*)	6	–
Acacia (*Acacia auriculiformis*)	6	0.5
A. hybrid	–	7
Basal area (m^2/ha)	5.08	5.10
Above ground biomass (tree/ha)	41.42	40.89

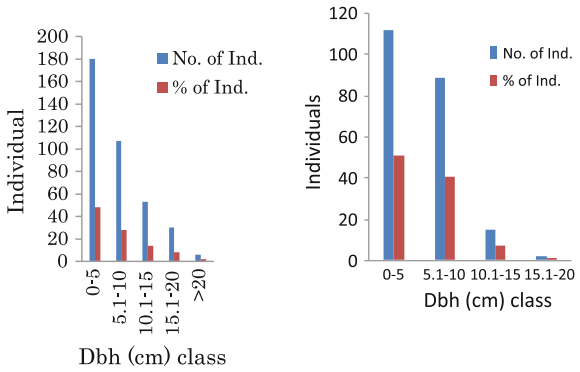

Fig. 3.3 Dbh (cm) distribution of plants in Betagi (*left*) and Pomra (*right*)

3.4 The SWOT Analysis

The SWOT analysis shows that there are considerable strengths of the CF project in the study area including the honest and dedicated initiatives by some local elites, unity among the participants to fulfill the targeted objectives, which was governed by a strong CF committee of their own, tenure security as in the case of Betagi, financial and material support at the initial stage of the project and reduction of rate of deforestation by the participants as well as the social crimes in the area (Fig. 3.4).

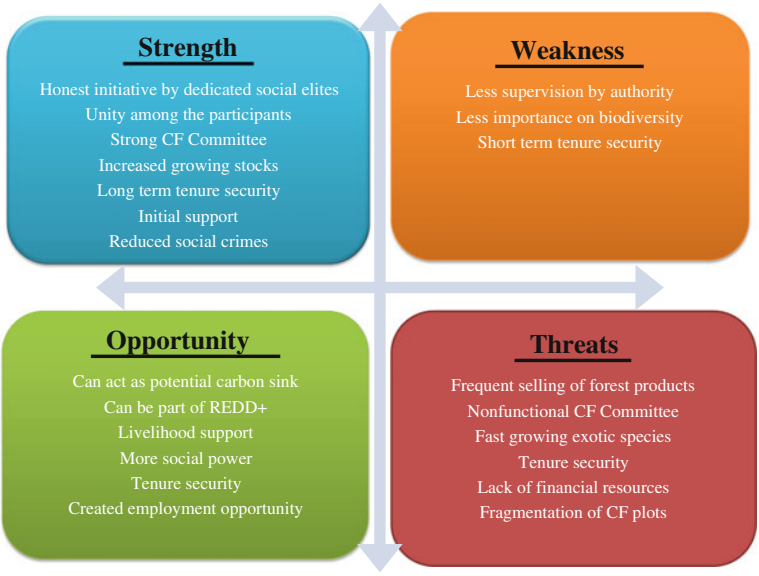

Fig. 3.4 Findings of SWOT analysis in the Betagi–Pomra CF Project

Irregular supervision from the government authority, giving less importance to conserve biodiversity, and tenure insecurity as in the case of Pomra having one year renewable lease contract are some of the weaknesses of the CF project as mentioned by the project participants.

Again, CF project can act as important carbon sink as seen from the vegetation study that can be a potential part of REDD+ program with substantial livelihood support to the participants, giving the poor participants more social power, and creating more employment options are some of the important opportunities of the CF projects as discussed by the participants. However, there are still some potential threats to the project such as frequent selling of the forest products thereby reducing the carbon stock from the forest, planting of fast-growing exotic species giving less importance to biodiversity, lack of sufficient financial support to run the project activities, and fragmentation of the CF plots among the offspring of the project participants and establishment of more houses thereby reducing areas under tree cover (Fig. 3.4).

3.5 Conclusions

The case study revealed that the socioeconomic situation of the project participants has improved significantly. Most of the "livelihood assets " (human, social, physical, natural, and financial capitals) were found to be positively improved from the project. Human capital in the project area has improved both in quantitative and in qualitative terms. Although the literacy rate has improved very meagerly, there was positive improvement in the quality of education in both secondary and higher level of education. There was also significant increase in family size. Family members' age gradation shows that majority members (66 % in Pomra and 64 % in Betagi) are of the 11–59 years age class meaning they are more capable of earning their livings. It was observed from the key-informants interviews and group discussions that they are more united now and face all the difficult situations (such as natural disaster, harassment from social elites, and observing religious or cultural festivals) collectively. However, this social capital is stronger in Pomra than in Betagi as the CF committee is virtually inactive in Betagi. The condition of their living houses, an important part of the physical capital, has also improved with majority of the houses having mud walls (70–82 %) and tin roofs (90 %), and floor of few houses was made of brick and cement (5–8 %).

There were no remarkable changes in livestock status among the respondents in both study sites. But in the case of household appliances, we noticed that many of them now possessed expensive and luxury items such as television (32–75 %), sound system (49 %), bicycle (60–79 %), motor cycle (11–16 %), CNG taxi (11–20 %),

tractor (7–8 %), and mobile phones (100 %). Some of the respondents (20 %) in the study area were found to use gas for cooking purposes along with firewood, leaves and twigs, and cow dung. Remarkable change has happened in the source of drinking water from stream (56–78 %) at BP to tube well (80–84 %) at AP. We found that number of daily laborer has dropped into 10–13 %, but number of farmers has increased to around 50 %. Few family members of some respondents are reported to work in abroad (8–20 %), some are doing jobs at home (15–20 %), and some have bought CNG taxis which they drive by themselves (7–8 %) for commuting passengers and earn extra income. The mean annual income of the participants has also increased around fivefolds from around BDT 35000 at BP to around BDT 160000 at AP. With this amount of income, 50 % respondents commented that they could manage all of their household expenses and could save some amount. Only around 12 % respondents reported to face food shortage while more than 50 % respondents had experienced food shortage at BP. Respondents also said that with surplus income many of them purchased land from the neighbors accumulating an extra 55 decimals of agricultural and hilly lands.

Vegetation study in respondents' plots identified 34 and 21 species in Pomra and Betagi, respectively, with dominant species being gamar (*Gmelina arborea*), segun (*Tectona grandis*), kanthal (*Artocarpus heterophyllus*), mahagoni (*Swientonia macrophylla*), and jarul (*Lagerstroemia speciosa*). The density of trees seems low if we consider a density of 2500 tree/ha in 2 m $\times$ 2 m spacing. The reasons may include some plants had died or felled and not replanted. Growth (in terms of basal area and biomass) of trees indicates that the participants had planted these 10–15 years before and at the beginning of the project they planted short-rotation species.

Analysis of BP and AP data shows significant positive changes in all livelihood capitals due to the project activities. The degraded forests have now been converted to plantations. One of the potential threats that might jeopardize the goals of CF in the project sites is the continuous fragmentation of land. Fragmentation of allocated CF plots due to population growth and division of family seems a serious menace for the sustainability of CF. Results showed that number and area of houses had increased 2–3 times than the beginning of the project. According to Muslim family rules, both son(s) and daughter(s) will get equal quantity of land of their parents. If this rule is applicable to the participants, then we could imagine that after several generations there would be no land for forest in the project sites and whole area will be occupied with houses. Although agreement does not permit to sale land, we were told that few participants sold their plots verbally and shifted to other places. We were also informed that a few participants sold their plots because of the non-availability of electricity in the villages. Regular monitoring by the FD staff members and, if necessary, review of agreement might be helpful to prevent land fragmentation.

Annex 3.1 Plant composition, frequency, basal area, and biomass in Pomra CF

Species name	Ind. No.	Frequency (%)	BA (m^2)	% of BA (m^2)	Biomass (Kg)	Biomass/tree (Kg)
Akashmoni (*Acacia auriculiformis*)	23	6.117021	0.074	3.413284	554.5	24.1087
Asar (*Grewia nervosa*)	3	0.797872	0.004	0.184502	39.32	13.10667
Am (*Mangifera indica*)	9	2.393617	0.008	0.369004	199.83	22.20333
Amra (*Spondias pinnata*)	1	0.265957	0.0002	0.009225		
Ata (*Annona squamosa*)	2	0.531915	0.0002	0.009225		
Bohera (*Terminalia bellirica)*	1	0.265957	0.0006	0.027675		
Chalta (*Dillenia indica*)	1	0.265957	0.0003	0.013838		
Chapatish (*Artocarpus chaplasha*)	18	4.787234	0.327	15.08303	2573.72	142.9844
Chatian (*Alstonia scholaris)*	2	0.531915	0.003	0.138376		
Dharmara (*Stereospermum colais)*	1	0.265957	0.0001	0.004613		
Gamar (*Gmelina arborea*)	98	26.06383	0.509	23.47786	3960.74	40.41571
Garjan (*Dipterocarpus turbinatus*)	1	0.265957	0.014	0.645756		
Ghoraneem (*Melia azederach*)	1	0.265957	0.0004	0.01845		
Guava (*Psidium guajava*)	2	0.531915	0.0015	0.069188		
Horinagula (*Vitex peduncularis)*	1	0.265957	0.014	0.645756		
Jam (*Syzygium cumini*)	3	0.797872	0.001	0.046125		
Jambura (*Citrus maxima*)	1	0.265957	0.009	0.415129		
Jarul (*Lagerstroemia speciosa*)	7	1.861702	0.059	2.721402		
Kanthal (*Artocarpus heterophyllus)*	58	15.42553	0.082	3.782288	1431.33	24.6781
Koroi (*Alibizia* spp.)	4	1.06383	0.205	9.45572	2163.53	540.8825
Lebu (*Citrus limon*)	8	2.12766	0.013	0.599631		
Litchi (*Litchi chinensis*)	7	1.861702	0.013	0.599631		
Lohakath (*Xylia xylocarpa*)	3	0.797872	0.006	0.276753		
Lombu (*Dysoxylum excelsum)*	1	0.265957	0.0003	0.013838		
Mahagoni (*Swientonia macrophylla*)	2	0.531915	0.006	0.276753		
Minjiri (*Senna siamea*)	24	6.382979	0.331	15.26753	2580.48	107.52
Papaya (*Carica papaya*)	2	0.531915	0.0008	0.0369		

(continued)

Annex 3.1 (continued)

Species name	Ind. No.	Frequency (%)	BA (m^2)	% of BA (m^2)	Biomass (Kg)	Biomass/tree (Kg)
Pitraj (*Aphanamixis polystachya*)	1	0.265957	0.0003	0.013838		
Purush (*Lagerstroemia indica)*	1	0.265957	0.0006	0.027675		
Segun (*Tectona grandis*)	78	20.74468	0.446	20.57196	2599.62	33.32846
Sonalu (*Cassia fistula*)	1	0.265957	0.0001	0.004613		
Supari (*Areca catechu*)	9	2.393617	0.013	0.599631		
Tula (*Bombax ceiba*)	1	0.265957	0.0006	0.027675		
Udal (*Firmiana colorata)*	1	0.265957	0.025	1.153137		
Total species = 34; Density 875 plants/ha; Total BA = 5.08 m^2/ha; Biomass = 41.42 tree/ha						

Annex 3.2 Plant composition, frequency, basal area, and biomass in Betagi CF

Species	Ind. No.	Frequency (%)	Basal area (m^2)	Basal area (%)	Biomass (Kg)	Biomass/tree (Kg)
Akashmoni (*Acacia auriculiformis*)	1	0.458716	0.008	1.049869		
Am (*Mangifera indica*)	1	0.458716	0.001	0.131234		
Chapalish (*Artocarpus chaplasha*)	4	1.834862	0.01	1.312336		
Chikrassi (*Chukrasia tabularis*)	3	1.376147	0.005	0.656168		
Fuljumuri (*Anogeissus acuminata*)	1	0.458716	0.004	0.524934		
Gab (*Diospyros blancoi*)	1	0.458716	0.005	0.656168		
Gamar (*Gmelina arborea*)	11	5.045872	0.026	3.412073	147.91	13.44636
Garjan (*Dipterocarpus turbinatus*)	6	2.752294	0.02	2.624672		
Guava (*Psidium guajava*)	1	0.458716	0.005	0.656168		
Hybrid (*Acacia* hybrid)	15	6.880734	0.053	6.955381	311.16	20.744
Jalpai (*Elaeocarpus serratus*)	6	2.752294	0.009	1.181102		
Jam (*Syzygium cumini*)	6	2.752294	0.012	1.574803	79.99	13.33167
Jarul (*Lagerstroemia speciosa*)	23	10.55046	0.244	32.021	2634.71	114.5526
Kadam (*Neolamarckia cadamba*)	3	1.376147	0.001	0.131234		

(continued)

Annex 3.2 (continued)

Species	Ind. No.	Frequency (%)	Basal area (m^2)	Basal area (%)	Biomass (Kg)	Biomass/tree (Kg)
Kathal (*Artocarpus heterophyllus)*	14	6.422018	0.024	3.149606		
Mahagoni (*Swientonia macrophylla*)	40	18.34862	0.11	14.4357	825.91	20.64775
Segun (*Tectona grandis*)	66	30.27523	0.192	25.19685	1332.46	20.18879
Sal (*Shorea robusta*)	1	0.458716	0.001	0.131234		
Tal (*Borassus flabellifer*)	1	0.458716	0.001	0.131234		
Telsur (*Hopea odorata*)	13	5.963303	0.024	3.149606		
Toon (*Toona ciliata*)	1	0.458716	0.007	0.918635		
Total species = 21; Density = 1453 plants/ha; Basal area = 5.10 m^2/ha; Biomass = 40.89 tree/ha						

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Chapter 4
Co-management of Protected Areas (PA): A Paradigm Shift in PA Management

Since 2004, initially the Nishorgo Support Project (NSP) and later Integrated Protected Area Co-management (IPAC) project in collaboration with Bangladesh forest department (FD) have been implementing protected areas (PA) co-management in Bangladesh that aimed to protect rapidly deteriorating forest biodiversity of the country. Drawing on data from the Chunati Wildlife Sanctuary (CWS), in this chapter we examined peoples' dependency on forest resources of CWS, forest health conditions, functions of co-management structure at local level, and impact on forest conservation. Household and forest trail surveys show that local people are heavily dependent on CWS's forests for own use and income. Local people clear forestland for betel leaf cultivation, sungrass production, and other agricultural practices. Forest vegetation survey recorded 93 tree species with a density of 239 trees/ha of which seven (07) exotic species contributed 60 %. Nearly 90 % trees belong to 5–15 cm dbh (diameter at breast height) producing a minimum biomass of 33.3 tree/ha. We observed a four-tier co-management governance structure at local level consisted of village conservation forums (VCF), peoples' forums (PF), community patrol groups (CPG), and co-management committee (CMC) with each component having their own functions. We found a lack of coordination among local-level co-management structure, NSP, IPAC, and FD. Although CMC was empowered by a government order to perform PA management-related functions, NSP or IPAC took all managerial decisions. In official documents, there was existence of VCF, but we noticed no activities during baseline survey although later on they were involved in GIZ project. The gap between promises and actual provisions had created distrust between CPG and others (CMC, NSP, IPAC, and FD). However, CPG's continuous patrolling reduced the incidence of illegal logging and the CWS is regaining its old forest growth. We recommend several policy implications for reducing misunderstandings among stakeholders and to ensure sustainability of PA co-management in CWS.

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4.1 Concept and Principles of Co-management

The term "co-management" is relatively recent and protected area co-management did not become widespread until the 1990s (Borrini-Feyerabend et al. 2000). It has had a profound impact on natural resource management and recent efforts to integrate ecology, economics, and society (Plummer and Armitage 2007). In the late 1970s, the issue of multi-stakeholder conflicts in protected areas (PA) emerged with prominence and the search for alternative approaches to management began (Plummer and Fennell 2009). Many resources including protected areas are too complex to be governed effectively by a single agency and require collaborative action by multiple partners (Berkes 2009; Zurba et al. 2012).

The co-management of PA means a PA in which the power and responsibility for resource management are shared (to a greater or lesser extent) between the state and local resource users and/or their representative organizations (Caruso 2011). It is an arrangement that brings several stakeholders in a platform to perform a variety of activities such as power sharing, joint decision making by the state, and communities about a set of resources or an area (Armitage et al. 2007). It is a pluralist approach to managing natural resources, incorporating a variety of stakeholders as partners in a variety of roles, to achieve the goals of environmental conservation, sustainable use of natural resources, and the equitable sharing of resource-related benefits and responsibilities (Borrini-Feyerabend et al. 2000).

The co-management establishes institutional links, bridges local level and government level(s), and is concerned with the empowerment of resource users and communities (Plummer et al. 2012). It ensures effective management of resources through empowering different stakeholders and harmonizing their conflicting interests (Kideghesho and Mtoni 2008). Co-management, or the sharing of power and responsibility between the government and local resource users, deals with not only administration of natural resources but also social relationship (Carlsson and Berkes 2005; Berkes 2009). It captures the idea that rights and responsibilities should be shared among those with a claim to the environment or a natural resource (Plummer 2009). When there are diversified interests among parties that create conflicts, co-management requires policies and mechanisms in situ for dispute management (Nursery-Bray and Rist 2009).

The definitions and conceptualizations of co-management in the literature have some common underpinnings (Carlsson and Berkes 2005): they explicitly associate the concept of co-management with natural resources management, having some kind of partnership between public and private actors, and stress that co-management is not a fixed state but a process that takes place along a continuum. These conceptualizations had triggered to emerge several aspects or principles that can be used to evaluate the performance of co-management. These include the following:

4.1.1 Co-management as Partnership Building and Sharing of Power and Responsibility

Besides inhabiting and adjacent local communities, many agencies may associate with natural resources or protected areas management. Each of them might have differentiating interests and make the areas a conflicting arena. For an amenable solution, formation of partnership among partners is crucial and active cooperation and participation of the resource users is vital. Active participation of partners in co-management process is directly related to their sense of ownership and commitment to the co-management arrangements (Ming'ate 2012). Partnership and cooperation will be meaningful when partners share their power and responsibility in the management of resources. In most countries, resource management falls under the jurisdiction of the central or state government, but there may be arrangements for sharing power and responsibility with users (Berkes 2009). Kruse et al. (1998) commented that assessment of power sharing can be used as criteria in measuring the success of co-management.

4.1.2 Strengthening and/or Formation of Institution

Local institutions related to natural resource use and management are usually present at sites. Co-management arrangement may strengthen these rules and regulations for better management of resources. In case of inefficiency and non-existence of institutions, new institutions may evolve. Co-management can evolve spontaneously through feedback learning over time, on identifying appropriate local institutions and building on their strengths, or creating new institutions where the existing ones do not work or are not appropriate (Ostrom 2005; Berkes 2009). Creating a favorable policy environment assists the emergence of functional co-management arrangements (Berkes 2009). Interrelations between state policy and local institutions are important for the emergence of co-management (Armitage et al. 2007).

4.1.3 Co-management and Social Capital

In order to ensure effective collaboration, it is imperative to have social relationship, networks, and trust among partners. Social capital in the form of trust, networks, and reciprocity enhances collective action and reduces problems of resource expropriation by setting appropriate rules. Social capital acts as a catalyst helping partners/groups to progress through the stages of the co-management process (Plummer and FitzGibbon 2006). Trust appears to be a determinant of success in many cases of co-management, as a prelude to building a working relationship

(Berkes 2009). Higher levels of social trust and trust in institutions are connected with the management of the PA and higher perceived benefits (Jones et al. 2012). Social capital and governance are interrelated; while social capital generates a foundation for collective action, the practice of good governance ensures its continuation, which facilitates the sustainability of program outcomes (Nath and Inoue 2008).

4.1.4 Co-management as Adaptive Management Process

Co-management is not a fixed state but emerges out of extensive deliberation and negotiation, and the actual arrangement itself evolves over time where the relationships among partners are constantly changing (Carlsson and Berkes 2005; Chuenpagdee and Jentoft 2007; Berkes 2009). Continuous changes necessitate the generation of alternatives that might adapt to new situations. Although co-management evolves adaptively as a result of collaborative problem solving, adaptive management requires collaborative processes to establish consensus among parties before feedback-based problem solving can proceed indicating that co-management and adaptive management complement one another (Berkes 2009; Zurba et al. 2012).

Adaptive co-management brings together two well-established traditions in natural resources management that uniquely combines the cooperative and participatory elements of collaborative management and the iterative and learning aspects of adaptive management (Plummer and Hashimoto 2011; Plummer et al. 2012; Plummer and Baird 2013). It forges links (both horizontal and vertical) for shared learning-by-doing between various actors, over a medium-to-long time horizon (Plummer et al. 2012), and is receiving considerable attention as an innovative governance strategy to sustain social–ecological systems (Plummer 2009).

4.1.5 Co-management and Governance

Co-management literature confirms that the direct involvement of people in resource management decisions that affect their livelihoods is good governance (Berkes 2009). Governance is an arrangement which distributes power and authority among different stakeholders and enables both societies and relevant legitimate institutions, mainly those part of government structures, to interact with each other in a responsive and accountable way for the interests of the society to ensure fairness in decision making, benefit distribution, and a voice for each and every stakeholder (Nath and Inoue 2008). The idea of governance helps communities take action in collaboration with government authorities for their interests. Co-management as governance often involves a diversity of players including

public and private actors, and this polycentric approach recognizes that effective governance often requires multiple links across levels and domains and seeks overlapping (Berkes 2009). Actors from diverse spheres of society (and at multiple levels) and who have varying principal interests enter into a process to generate shared understanding of an issue or problem (Plummer and Baird 2013).

4.2 Co-management of Protected Areas in Bangladesh

Forests of Bangladesh have been under serious threats from many factors including ruthless illegal logging, deforestation, encroachment, and expansion of mono plantations of exotic species resulting in the loss of forest coverage and its rich biodiversity. In order to arrest the forest loss and biodiversity, the government of Bangladesh had declared patches of forests as protected areas under the provision of the Forest Act 1927 and the Bangladesh Wildlife (Preservation) Order 1973. Since 1960s, a number of protected areas had been declared in the country (Table 4.1). Protected areas (PA) here refer to those forest protected areas designated as national parks, game reserves, wildlife sanctuaries, safari parks, or eco-parks under the statute (Mukul et al. 2008; DeCosse et al. 2012a). Most declared protected areas

Table 4.1 List of PA in Bangladesh (*NP* national park, *WS* wildlife sanctuary, *EP* eco-park, *SP* safari park. *Source* BFD 2015; official website of Bangladesh forest department (http://www.bforest.gov.bd/))

Sl. No.	Name of PA	Main habitat	Location	Est. in	Area (ha)
1	Himchari NP	Mixed evergreen forest in hills	Cox's Bazaar	1980	1,729
2	Madhupur NP	Moist deciduous forest in hillocks	Tangail, Mymensingh	1982	8,436
3	Bhawal NP	Moist deciduous forest in hillocks	Gazipur	1982	5,022
4	Lawachara NP	Mixed evergreen forest in hills	Moulvibazaar	1996	1,250
5	Kaptai NP	Mixed evergreen forest in hills	Rangamati	1999	5,464
6	NijhumDweep NP	Mangrove forest on coastal island	Noakhali	2001	16,352
7	Ramsagar NP	Large lake surrounded by plantation	Dinajpur	2001	28
8	Satchari NP	Mixed evergreen forest in hills	Habiganj	2005	243
9	Khadimnagar NP	Mixed evergreen forest in hills	Sylhet	2006	679

(continued)

Table 4.1 (continued)

Sl. No.	Name of PA	Main habitat	Location	Est. in	Area (ha)
10	MedhaKachhapia NP	Dipterocarp forest in hillocks	Cox's Bazaar	2008	396
11	Baraiyadhala NP	Mixed evergreen forest in hills	Chittagong	2010	2,934
12	Shingra NP	Moist deciduous forest	Dinajpur	2010	306
13	Kadigarh NP		Mymensingh	2010	344
14	Nababganj NP	Moist deciduous forest	Dinajpur	2010	518
15	Kuakata NP	Mangrove forest in lowland coast	Patuakhali	2010	1,613
16	Birganj NP	Moist deciduous forest	Dinajpur	2011	169
17	Altadighi NP	Moist deciduous forest	Naogaon	2011	264
18	Char Kukri-Mukri WS	Mangrove forest on coastal island	Bhola	1981	40
19	Rema-Kalenga WS	Mixed evergreen forest in hills	Habiganj	1982	1,796
20	Pablakhali WS	Mixed evergreen forest in hills	Rangamati	1983	42,087
21	Chunati WS	Degraded bamboo and other vegetation in hills	Chittagong, Cox's Bazaar	1986	7,764
22	Sundarbans East WS	Mangrove forest in lowland coast	Bagerhat	1996	31,227
23	Sundarbans South WS	Mangrove forest in lowland coast	Khulna	1996	36,970
24	Sundarbans West WS	Mangrove forest in lowland coast	Satkhira	1996	71,502
25	Fashiakhali WS	Mixed evergreen forest in hills	Cox's Bazaar	2007	1,302
26	Dudphukuria-Dopachari WS	Mixed evergreen forest	Chittagong	2010	4,717
27	Sangu WS	Mixed evergreen forest	Bandarban	2010	2,332
28	Hazarkhil WS	Mixed evergreen forest	Chittagong	2010	1,178
29	Teknaf WS	Mixed evergreen forest in hills	Cox's Bazaar	2010	11,615
30	Tengragiri WS	Mangrove forest in lowland coast	Barguna	2010	4,049
31	Sonar Char WS	Mangrove forest in lowland coast	Patuakhali	2011	2,026

(continued)

Table 4.1 (continued)

Sl. No.	Name of PA	Main habitat	Location	Est. in	Area (ha)
32	Dudhmukhi WS	Mangrove forest in lowland coast	Bagerhat	2012	170
33	Dhangmari WS	Mangrove forest in lowland coast	Bagerhat	2012	340
34	Chandpai WS	Mangrove forest in lowland coast	Bagerhat	2012	560
35	Nazirganj WS	Dolphin WS in river ecosystem	Pabna	2013	146
36	Silonda-Nagdemra WS	Dolphin WS in river ecosystem	Pabna	2013	24
37	Nagarbari-Mohanganj WS	Dolphin WS in river ecosystem	Pabna	2013	408
38	Swatch of no ground	Marine protected area	Bay of Bengal	2014	173,800
39	Sitakunda EP	Mixed evergreen forest in hills	Chittagong	1998	808
40	Madhutila EP	Moist deciduous forest in hillocks	Sherpur	1999	100
41	Madhabkunda EP	Mixed evergreen forest in hills	Moulvibazaar	2001	266
42	Banshkhali EP	Degraded bamboo and other vegetation in hills	Chittagong	2003	1,200
43	Kuakata EP	Mangrove forest in lowland coast	Patuakhali	2005	5,661
44	Tilagarh EP	Mixed evergreen forest in hills	Sylhet	2006	45
45	Barshijora EP	Mixed evergreen forest in hills	Moulvibazaar	2006	326
46	Bangabandhu SP	Dipterocarp forest in hillocks	Cox's Bazaar	1997	900
47	Bangabandhu SP	Moist deciduous forest	Gazipur	2013	1,494
48	Baldah Garden	Botanical garden	Dhaka	1909	1
49	National Botanical Garden	Botanical garden	Dhaka	1961	84
Total protected area				450,685	

have been carved out of existing reserve forestland and continue to have borders with existing reserve forests, so the Forest Act 1927, which governs many aspects of reserve forest use, is directly relevant to biodiversity conservation (DeCosse et al. 2012b). However, simple declaration of PA has not functionally worked in the prevention of loss of biodiversity because local communities are put to hardships

after notification of a forest as PA mainly due to the curtailment of the flow of forest resources for their livelihoods through strict regulation (Chowdhury and Koike 2010). 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 protected areas (Sarker and Roskaft 2011).

Co-management of PA is a policy target of Bangladesh under strategy 9 of the National Biodiversity Strategies and Action Plan (NBSAP) (GoB 2004). The new Wildlife Act (2012) also includes provisions for the participation of local stakeholders in the management and benefits of protected areas under Article 21: *(1) The Government may introduce co-management system for proper utilization, conservation and management of natural resources of the sanctuary involving forest department, minor ethnic community living in the forests or local community on participatory basis to ensure active participation of all the parties therein. (2) The Government may, for the purpose of sub-section (1), constitute a committee named as co-management committee and may specify terms of reference of such committee.*

According to government order (GO) issued by the Ministry of Environment and Forests (MoEF) in 2009, a co-management council and co-management committee can be developed in each protected area to conserve biodiversity and sustainable ecosystem management (MoEF 2009). The GO outlines that a co-management council shall be formed with a maximum of 65 members, including at least 15 female members headed by UNO as president and a range officer (RO) as a member secretary for a period of four years. The council will also include 22 members (maximum) from the peoples' forum or resource users' federation directly elected by the local community people living around the protected area and including 33 % female members. The local MP, Upazila chairman, and concerned DFO will act as advisors for the council. The GO also specifies the responsibilities of both the co-management council and co-management committee. The most important responsibility for the co-management committee is that they have to ensure proper expenditure of the revenue earned as per the government-prescribed rules from entry fees for community development and biodiversity conservation.

International conservation meetings highlight the importance of recognizing the role of local communities in PA use and management, and in Bangladesh, there is no choice but to engage with such local communities, because they are already combing through the forest every day (DeCosse et al. 2012a). In 2004, with funding from the US Agency for International Development (USAID), the Nishorgo Support Project (NSP) initiated a pilot project using a co-management approach in five protected areas with the active participation of local communities (Fig. 4.1; Chowdhury and Koike 2010; Sarker and Roskaft 2011; DeCosse et al. 2012c). In 2008, the FD and USAID extended co-management in 17 PA and one eco-park through Integrated Protected Area Co-management (IPAC) project with the aim of improving local people's livelihoods through greater access to and control over local forest resources (Begum 2011).

History says that adoption of PA co-management by the USAID was inspired with the successful implementation of fisheries co-management in the country

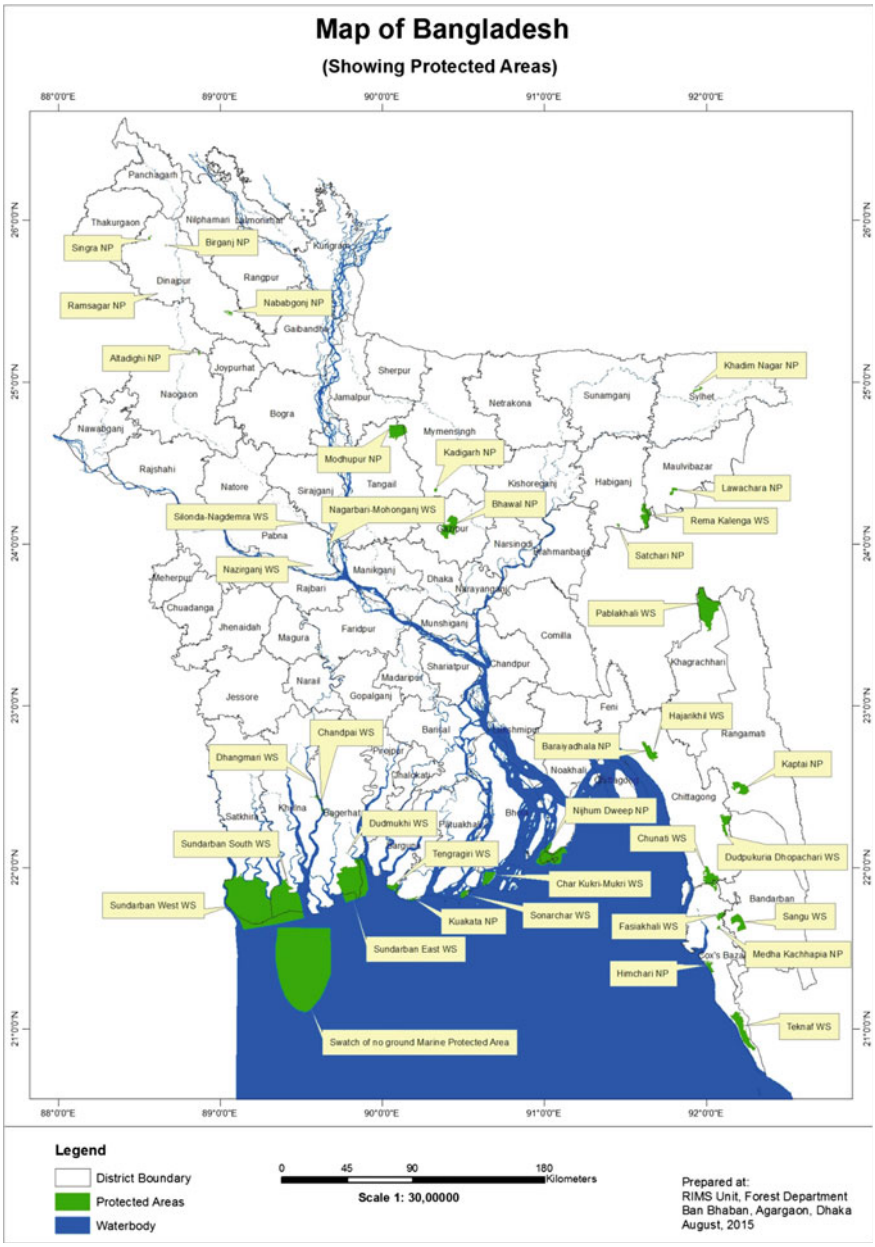

Fig. 4.1 Map of Bangladesh showing locations of protected areas (*Source* official website of Bangladesh forest department (http://www.bforest.gov.bd/))

which contributed to biodiversity conservation as well as livelihood improvements of local communities (Mazumder and Thompson 2012). Community involvement in protected area management, a relatively new practice in Bangladesh, initiated with the dual purpose of limiting forest degradation and enhancing community development (Chowdhury et al. 2013).

4.3 Co-management of Chunati Wildlife Sanctuary: The Case Study

Chunati Wildlife Sanctuary (CWS) covering seven reserved forest (RF) blocks/beats of hill forests is located in the country's southeastern region (Fig. 4.2). It represents a fragile forest landscape near the Bay of Bengal, which, if not conserved soon, may be lost for the future generation. Anthropogenic pressures including increased commercial extraction of forest produce, brought by manifold increase in human population, led to widespread shrinkage and deforestation of hill forests. Due to unsustainable forest management practice, natural forests are practically non-existent in CWS. Encroachment, fuel wood collection, illegal timber extraction, conversion of natural forest to agriculture, and betel leaf cultivation are putting significant biotic pressure on forest resources, leaving the area covered with secondary scrub vegetation with individual scattered trees. Conversion of natural forests to fast-growing plantation (mainly acacia, mangium, etc.), orchards (mainly mango, lemon, jalpai, litchi, etc.), and sungrass production areas by burning forest resources especially the saplings and seedlings is also putting serious threats on the biodiversity of the CWS (GIZ 2015). The CWS has been managed by the Wildlife Management and Nature Conservation Division, Chittagong, under Bangladesh forest department. It consists of two forest ranges (Table 4.2).

Until the mid-1980s, much of this area is comprised of evergreen forests, but there has been extensive logging and encroachment since that time which accelerated when settlers moved into the area after the 1991 cyclone (DeCosse et al. 2012a). It has been reported that nearly 50,000 people have been living in or adjacent to the CWS who are mostly very poor and heavily dependent on its resources for their livelihood. Large tracts of forestland have been denuded, and numerous species of flora and fauna were lost over the past few decades.

In order to prevent forest degradation and to protect the wildlife, mainly of Asian elephant, Chunati reserve forest was declared as the Chunati Wildlife Sanctuary (CWS) in 1986. However, only declaration was not sufficient and forest loss was continuing in the CWS resulting in the reduction of wildlife population. Nishorgo Support Project and Integrated Protected Area Co-management (IPAC) funded by the USAID have been supporting the forest department (FD) in establishing collaboration between local people, non-government organizations, and the FD for co-management of forest resources in the CWS. Besides implementing a

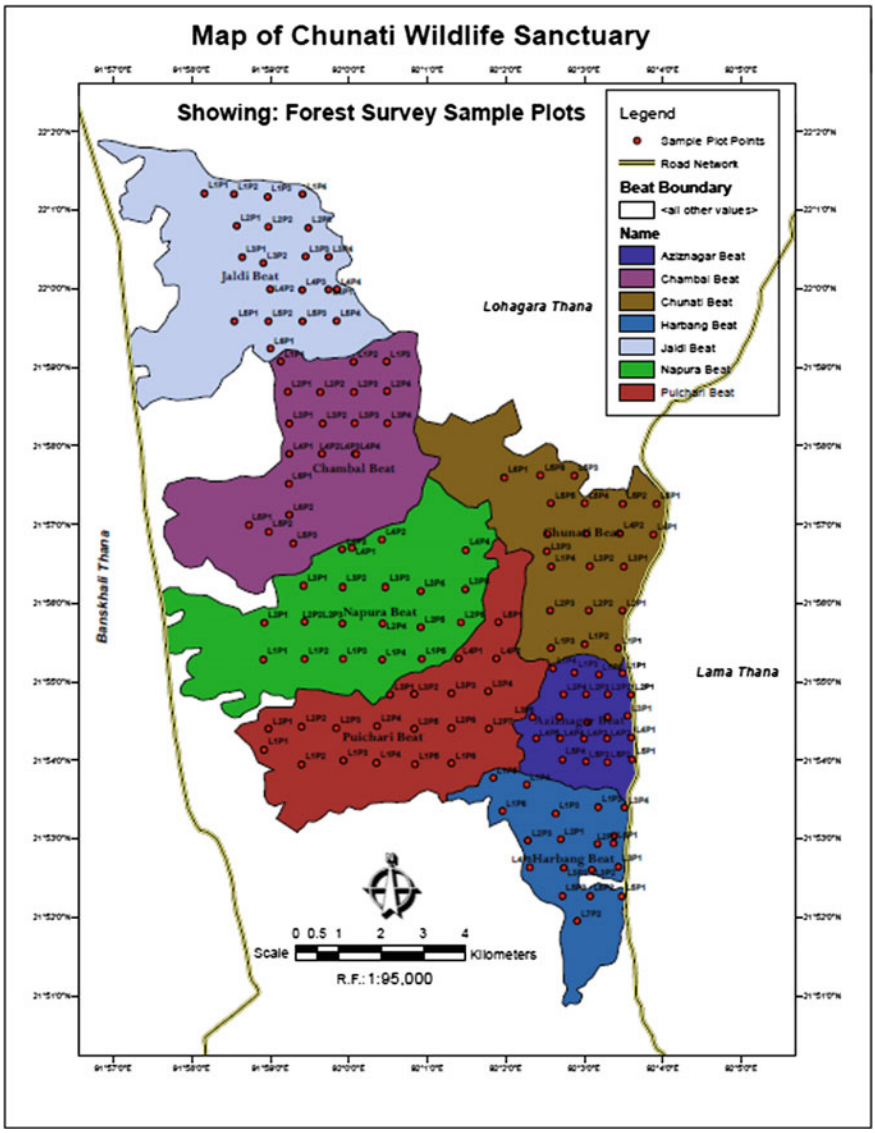

Fig. 4.2 Map of the CWS showing seven beats and vegetation survey sample plot points

co-management model, CWS has to be also restored not only to benefit the communities, but also to help trap carbon dioxide and thus reduce greenhouse gas emissions, protect endangered species, and conserve the water supply in the region. Hence, the Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ) GmbH was providing technical cooperation on behalf of the German Federal Ministry of

Table 4.2 Name and area of forest ranges and beats of the CWS (*Source* Chunati and Jaldi Forest Range 2011)

Range name	Beat name	Area (ha)
Chunati	Chunati	1159.10
	Aziznagar	511.76
	Herbung	939.65
Jaldi	Jaldi	1148.58
	Chambal	1040.89
	Napora	1609.31
	Puichari	1354.65
Total = 7763.94 ≈ 7,764		

Economic Cooperation and Development (BMZ) to the Bangladesh forest department (FD) of the Ministry of Environment and Forest (MoEF), so that local communities were also involved in the efforts to conserve and reforest the area, while equitably sharing the benefits of forest resources (GIZ 2015).

The GIZ support was integrated with other development partners working in this region, and it was cooperating with the Integrated Protected Area Co-management (IPAC) project, funded by the United States Agency for International Development (USAID). The GIZ project (2009–2015) aimed to improve the sustainable participatory forest management in CWS focusing on incentives for people living in and around the sanctuary as well as on protection and enrichment of the forest. Although local people have become aware of the values of forests and wildlife, they still needed external support in order to enhance their livelihood. Unless there are viable options of livelihood, peoples' dependency on forest resources cannot be reduced which might jeopardize the objectives of establishing the CWS. In this chapter, based on a baseline and final evaluation survey of the GIZ project, we examined:

- Peoples' dependency on forest resources and how the GIZ project helped to reduce it;
- Current forest health of the CWS and impacts of co-management on forest conservation; and
- The co-management structure and functions at local level.

4.3.1 Methodological Approach

The study was based on household surveys, focus group discussion, key-informants interviews, forest trail survey, and vegetation survey. It was conducted in two phases—baseline in July–December 2011 and final evaluation survey in January–June 2015.

4.3.1.1 Household Survey, Key-informants Interview, and Group Discussion

In baseline survey, we observed that some household members in and adjacent to the CWS were involved in co-management of CWS as community patrol group (CPG) and village conservation forum (VCF). From IPAC official documents, we found that there were seven (07) including two (02) female CPGs and five (05) male CPGs in Chunati and Jaldi ranges, respectively, that consisted initially of 253 and 187 members, respectively. However, we found that only 208 and 84 active members in Chunati and Jaldi ranges, respectively, and others either quitted or deceased. Officials of IPAC said that there were 34 and 26 VCFs consisting of 1810 and 1485 members, respectively, in both ranges. We noticed that there were VCFs in official documents, but we could not find individual member's list for VCFs. Despite members, many listed representatives also did not know about VCFs. Virtually we did not observe any forest conservation activities of VCFs. Members of CPGs, both male and female groups, were found aware of forest conservation activities and took part in forest protection. Hence, considering their merits, we sampled all available CPG members (male and female) 208 and 94, respectively, for Chunati and Jaldi ranges for baseline household survey. We interviewed 184 and 142 VCF members from Chunati and Jaldi, respectively. In addition, we conducted household survey for 100 households, in each range, as control. They were not involved either with CPGs or with VCFs.

A pretested semi-structured questionnaire was used for conducting household survey. The questions included were related to basic socioeconomic features of households (household size, age, education, housing conditions, household appliances, water source, livestock, landholding status, occupation, income and sources, alternative income sources, etc.), forest resource extraction, their perception on, and knowledge of forest conservation. Household head, male or female, who was available took part in household interview.

A total of 15 focus group discussions, eight (08) with CPG members, three (03) with VCF members, two (02) with control members, and one (01) with co-management committee members were hold. Group discussion highlighted issues like history of their involvement in co-management and impact on forest conservation, their aspiration and achievement, and their opinion on conservation of CWS and enhancement of livelihood. A separate checklist was used to facilitate the discussion. Key-informants interviews were conducted with FD staff members at local level such as with forest rangers, beat officers, and guards. We asked them about their opinion on current and future of co-management approach and its impact on forest management.

For final evaluation survey, we collected official documents of Society for Health, Extension and Development (SHED), an NGO working for the livelihood improvement of the CPG and VCF members as part of the co-management activities supported by GIZ, and found that there were seven CPGs including Chunati (03 CPGs) and Jaldi (04 CPGs) ranges and that consisted of 166 and 105 members, respectively. We also noticed that there are 45 VCFs in both Chunati (22 VCFs)

and Jaldi (23 VCFs) ranges consisting of 1363 and 1264 members, respectively. In this survey, 56 CPG members and 695 VCF members were interviewed for collecting above-mentioned socioeconomic variables.

4.3.1.2 Forest Trail Survey

It has been observed and reported that there are several paths through which local people enter into the CWS and collect forest products that they sell into the local markets. In order to estimate forest products extraction by local people, we decided to conduct survey some of these paths or trails. For the selection of trails for survey, we talked to some key informants including local people, forest officials, and to some of forest products collectors. Based on their opinion, it was confirmed that there are 12–16 trails in Chunati range and 25–30 trails in Jaldi range that local people use for forest products extraction. Some of these trails are being used very frequently. This observation corroborates with SHED, a NGO, report which identifies 16 trails in Chunati and 36 trails in Jaldi range. For survey, we selected nine (09) trails in Chunati and 12 trails in Jaldi distributed in all seven (07) beats representing very frequently, medium frequently, and low frequently visited trails. Each trail was surveyed for a whole day. A research student accompanied with a local guide started survey in each trail early in the morning. Research students noted number of persons entered into the CWS with their sex and the time of entry. The products collectors were returning back just afternoon and continue till the evening. When they were returning with forest products as back- or shoulder load, notes were taken for products types, quantity, and market prices of these products. Local guide and products collectors assisted to estimate the quantity and prices. Market prices were also checked in local markets. A checklist was used for trail survey.

A similar survey was conducted in final evaluation study with 28 trails, 12 in Chunati and 16 in Jaldi, respectively.

4.3.1.3 Enumeration of Betel Leaf Plots

It was reported that local people have been cultivating betel leaf inside the CWS for a long time. But there were no data regarding the number of betel leaf plots and area under betel leaf cultivation. In order to estimate the number of betel leaf plots and area, we surveyed, both baseline and final evaluation, all seven beats of the CWS. Before survey, we interviewed some local betel leaf cultivators and forest officials and asked them to identify the trails through which we could count maximum number of betel leaf plots. In each beat, 3–4 trails were identified through which we visited the interior of the CWS and counted the number of betel leaf plots. Using GPS, geographic coordinates of betel leaf plots were located. Area of each plot was estimated in consultation with the farmers. Materials used for making betel leaf shed and their sources were noted. Farmers were also asked about the cultivation techniques of betel leaf.

4.3.1.4 Vegetation Survey

The CWS has two ranges and seven beats/blocks. Therefore, we followed a stratified and systematic sampling and laid out 140 circular plots (17.84 m radius), 20 plots in each block, considering time and other resources. The area of each plot was 0.1 ha, and the total sampled area was 14 ha. For locating plots, base map of every beat was copied on tracing paper, selected a point on map considering a nearby permanent feature, drawn four to five parallel lines on the map at an equal distance, and then put 20 plots proportionately and equally on the lines drawn. After identifying the point physically on the ground, we selected first plot on first line by using compass and a GPS (Global Positioning System) device (Garmin GPSmap76Cx). The coordinate of the center point of each plot was recorded, and the tree at the center point was marked using red color round the tree stem at breast height level by which the sample plots could be identified if needed. Distances from plot to plot and line to line were measured based on base map scale and then located by using GPS. With the help from a GIS (Geographic Information System) expert and using Google Earth Map, the coordinates of all plots have been laid out on respective beats of the CWS (Fig. 4.2). For regeneration study, 140 co-centric plots, each with 1.25 m radius (5 m^2), were laid out in seven beats.

A format was prepared for field data collection that included information on the name of forest range and beat, geographic coordinates, tree species name, diameter at breast height (dbh), canopy coverage, number of recently felled stump, and name and number of regenerating tree species. All trees having dbh ≥5cm in each plot were counted species wise, and corresponding dbh was measured. Canopy coverage in each plot was measured by ocular estimation. The number of recently felled stumps was counted. For regeneration, the number of seedlings/saplings was counted species wise. The common species were identified directly in the field. Local people and forest department staff members also helped in identifying some species. For unidentified species plant specimens, e.g., twigs, flowers, and fruits were collected and preserved as herbarium and later identified by a plant taxonomist at the Department of Botany, University of Chittagong.

4.3.1.5 Data Analysis

All quantitative data were compiled, summarized into mean, percentages, and standard deviation were derived, and conducted statistical tests (one way ANOVA, one sample Kolmogorov–Smirnov (K–S) test and Pearson's correlations test).

Data on vegetation were analyzed in four ways—the CWS as a whole, forest category (plantation, enrichment plantation, and natural forest), distance gradient (0–1000, 1001–2000, 2001–3000, and 3001–5300 m from periphery) and forest beat (Chunati, Aziznagar, Harbang, Jaldi, Chambal, Napura, and Puichari).

The Shannon–Wiener diversity index was calculated according to Michael (1990) as

$$\text{Diversity}, H = -\sum P_i L_n P_i$$

where P_i = No. of individuals of one species/total no. of all individuals in the sample.

Species diversity index was calculated on the basis of the following formula given by Kohli et al. (1996) as

$$\text{SDI} = \sum \log\ (n_i/N)/\log(1/s)$$

where n_i = number of individuals of each species; N = total number of trees of all species; and s = total number of species.

The indices of species richness (R) and evenness (E) were estimated employing the following formula given by Margalef (1958) and Pielou (1966), respectively-

$$R = (S-1)/\log N$$
$$E = H/\log s$$

where S = total number of species; N = total number of trees of all species; and H = the Shannon–Wiener diversity index.

The index of dominance (ID) was measured by Simpson's index (Simpsons 1949) as

$$\text{ID} = \sum (n_i/N)^2$$

where n_i = number of individuals of each species and N = total number of trees of all species.

Aboveground biomass: The following regression equation widely used to estimate the aboveground biomass of tropical forest trees was used (Brown 1997)

$$Y = 42.69 - 12.8\text{D} + 1.424\text{D}^2$$

where Y means aboveground biomass (kg) and D is the diameter (cm) at breast height level.

The disturbance index was estimated using the following formula given by Tripathi and Tripathi (2010):

$$\text{Disturbance index} = (\text{number of tree stumps}/\text{total number of trees including tree stumps}) \times 100$$

The basal area of the tree was calculated by the formula as given by Chaturvedi and Khanna (1982).

$$\text{Basal area/tree} = \frac{\Pi}{4} \times \mathrm{D}^2$$

The species density, relative density (RD), frequency, relative frequency (RF), relative dominance (RDo), abundance, relative abundance (RA), and IVI of each species were calculated using the following formula given by Moore and Chapman (1986):

$$\text{Density of a species} = \frac{\text{Total no. of species in all the quadrates}}{\text{Total no. of quadraates studies}}$$

$$\text{Relative density}\ (\%) = \frac{\text{Total no. of individuals of a species}}{\text{Total no. of individuals of all species}} \times 100$$

$$\text{Frequency of a species}\ (\%) = \frac{\text{Total no. of quadrates in which spp. occurs}}{\text{Total no. of quadraates studies}} \times 100$$

$$\text{Relative frequency}\ (\%) = \frac{\text{Frequency of one species}}{\text{Frequency of all species}} \times 100$$

$$\text{Abundance of a species} = \frac{\text{Total no. of individuals of a species}}{\text{Total no. of quadraates in which species occurs}}$$

$$\text{Relative abundance}\ (\%) = \frac{\text{Abundance of one species}}{\text{Abundance of all species}} \times 100$$

$$\text{Relative dominance}\ (\%) = \frac{\text{Combined basal area of a species}}{\text{Basal area of all species}} \times 100$$

Importance value index (IVI) for regeneration was calculated as sum of relative density (RD), relative frequency (RF), and relative abundance (RA), whereas the IVI for tree species was sum of relative density (RD), relative frequency (RF), and relative dominance (RDo).

4.4 Field Findings and Interpretations

In this section, first we describe the basic socioeconomic features of sampled households and then their dependency on the CWS followed by forest health, structure and functionality of co-management approach, and peoples' perception on conservation of the CWS. The impacts of the GIZ project on peoples' socioeconomic and forest conservation are also described.

4.4.1 Socioeconomic Features of the Households

Both in Chunati and in Jaldi forest range, mean age of the respondents was around 40 years. There were two female and five male CPG groups in Chunati. All five

CPG in Jaldi were formed by male members. Female CPG members were found active, and more than 50 % members of male CPG members both in Chunati and in Jaldi ranges were not active in their operations. In the village conservation forum (VCF), 66 % respondents in Chunati were male, while in Jaldi it was 86 %. In case of control, female members (69 %) dominated in Jaldi range (Table 4.3).

Average household size of sampled households in Chunati was around 6.0, while in Jaldi it was slightly less than 6.0. Majority of the household members belong to 11–59 age class, a physically active age class. Nearly 50 % respondents in Chunati were literate, while in Jaldi the mean literacy rate was less than 40 % because most of the members there were female who were usually less educated persons in the society. This was also evident from male/female literacy (Table 4.3).

More than 80 % of the houses of the sampled households across CPG, VCF, and control were made of mud wall (Table 4.3). Only a few households (3–11 %) have brick wall houses. In Chunati, 48 % CPG, 65 % VCF, and 71 % control members have tin roof houses, and in Jaldi, less than 35 % respondents have tin roof houses. Most of the houses in Jaldi were made with sungrass roof. There were no remarkable differences among CPG, VCF, and control respondents having livestock (Table 4.4). In the whole CWS areas, 56 % respondents had more than a cow and another 75 % respondents reported having about nine (09) poultry. Few respondents (10 %) had goat.

Landholding status indicates that respondents of Chunati had more than 82 decimal land in their possession that includes agricultural lands, homesteads, hills, and some land inside the CWS (Table 4.4). Of total landholdings, more than 50 % land is permanently held by them and rest is leased land. Occupational status indicates that the principal occupation of the respondents was agriculture followed by wage labor, small rural business, and services in manufacturing industries (Table 4.4). Some respondents are also involved in cottage industries, carpentry, etc.

Mean monthly income of the respondents across CPG, VCF, and control in both forest ranges was almost the same, and there was no significant difference. The average monthly income was BDT 5617 (Table 4.3). However, (K–S) test results [for CPG (K–S) $Z = 4.36$, $P < 0.001$; for VCF (K–S) $Z = 3.04$, $P < 0.001$; and for control (K–S) $Z = 1.55$, $P < 0.01$] show that within respondent's category, there were significant differences in monthly income. This indicates that there was income disparity among households of each category. Results of the correlation test indicate that household's total income was very much related to income from business (Pearson's correlation 0.47, $P < 0.001$) followed by income from service (Pearson's correlation 0.33, $P < 0.001$), agriculture (Pearson's correlation 0.26, $P < 0.001$), and wage labor (Pearson's correlation 0.13, $P < 0.001$). Some household members were working in industries in city areas, and their salaries contributed 25 % to household income. Agriculture added 12 %, while wage labor and rural business contributed 24 and 18 %, respectively, to household mean income. Forest resources extraction and sale, and livestock added 11 and 9 %, respectively.

Table 4.3 State of basic household information among respondents

Variable	Chunati range			Jaldi range			Whole CWS $N = 829$
	CPG ($N = 208$)	VCF ($N = 184$)	Control ($N = 101$)	CPG ($N = 94$)	VCF ($N = 142$)	Control ($N = 100$)	
Respondents' status							
Respondents' age (mean)	40	41	39	41	34	37	39
Mean household size (No.)	6 ± 0.14	6.0 ± 0.15	6.1 ± 0.2	6.3 ± 0.24	5.4 ± 0.14	5.4 ± 0.24	6 ± 0.07
Male:Female	1:1	1:1	1.1:1	1.1:1	1:1	1.3:1	1.03:1
Literacy (%) status							
Respondents	43	62	53	46	32	41	46
Total	51	59	49	50	23	66	48
House conditions (%)							
Mud wall	90	80	83	83	84	76	83
Bamboo wall	7	9	11	13	13	22	11
Brick wall	3	11	6	4	3	2	5
Tin roof	48	65	71	39	39	35	44
Sungrass roof	51	27	28	59	56	57	52
Tin + sungrass	–	6	–	2	5	8	4

Table 4.4 Livestock, landholding, and occupational status of the respondents

Variable	Chunati range			Jaldi range			Whole CWS $N = 829$
	CPG ($N = 208$)	VCF ($N = 184$)	Control ($N = 101$)	CPG ($N = 94$)	VCF ($N = 142$)	Control ($N = 100$)	
Mean number of livestock							
Cow	1.8 (64)	1.46 (51)	1.97 (58)	1.99 (62)	1.0 (43)	1.7 (59)	1.7 (59)
Goat	0.4 (13)	0.2 (9)	0.6 (13)	0.43 (12)	0.1 (5)	0.4 (13)	0.3 (10)
Poultry	8.0 (65)	10 (74)	7.9 (83)	13 (90)	5.8 (73)	5.9 (78)	8.6 (75)
Landholdings (decimal)							
Total	82.5	90.4	88.7	121.3	52.4	56.8	82.4
Principal occupations (%)							
Agriculture	47	29	43	65	28	33	40
Wage labor	34	19	29	25	37	24	28
Business	11	21	11	7	8	9	12
Service	4	12	7	3	9	9	8
Others	4	19	10	–	18	15	12

Note Figures in parenthesis indicate the percentage of respondents

Forest resources included fuelwood, sungrass, leaves, bamboo, and house broom which they sold after consumption. Income from forest resources indicated that respondents of Jaldi earn almost one and half times more than that of Chunati's respondents. It means that respondents of Jaldi exerted more pressure on forests than on Chunati range. The mean monthly expenditure was nearly BDT 5296 across all CPG, VCF, and control in both ranges (Table 4.5).

Forty-nine (49 %) percent of respondents had at least one loan from NGO (Table 4.6). However, female CPG members in Chunati reported that all of them took more than one loan from NGOs. The NGOs that provided loan were Grameen Bank, ASA, COAST, SHAKTI, BRAC, UDDIPAN, Muslim Aid, and Islami Bank. The purposes of loan included agriculture, business, emergency needs (e.g., sickness, marriage, and house construction), poultry, cattle, van, and carpentry. Out of 316 female respondents interviewed, 35 % of them reported to have a loan. Of 513 male respondents, 57 % said that they had a loan. Although 49 % had a loan, about 60 % respondents reported to had desire to get loan. Respondents commented that loan helped them to solve emergency needs, but they did not get sustainable benefits from loan. They reported that due to high interest rate and weekly or fortnightly repayment systems, they could not invest the loan money effectively in their business or other productive purposes and therefore did not obtain sustainable benefits.

Table 4.5 Mean monthly income of the respondents in the study area

Variable	Chunati range			Jaldi range			Whole CWS $N = 829$
	CPG ($N = 208$)	VCF ($N = 184$)	Control ($N = 101$)	CPG ($N = 94$)	VCF ($N = 142$)	Control ($N = 100$)	
Mean monthly income (Tk.)	5464 ± 675	5744 ± 699	5287 ± 366	5400 ± 827	6374 ± 486	5432 ± 642	5617 ± 350
Agriculture	535	785	670	524	889	690	682
Wage labor	1232	1164	1368	1249	1454	1520	1331
Business	1052	1283	921	1144	776	1055	1039
Livestock	805	546	381	869	166	346	519
Service	1250	1334	1491	1104	2159	1132	1412
Forest resources	590	632	456	510	930	689	635
Mean monthly expenditure (Tk.)	5440 ± 209	5410 ± 591	4911 ± 302	5212 ± 331	5618 ± 337	5139 ± 509	5296 ± 175

Note Figure followed by ± indicates standard error of mean

Table 4.6 Loan status, sources, and purposes

Variable	Chunati range			Jaldi range			Whole CWS $N = 829$
	CPG ($N = 208$)	VCF ($N = 184$)	Control ($N = 101$)	CPG ($N = 94$)	VCF ($N = 142$)	Control ($N = 100$)	
Having a loan (%)							
Yes	44	54	45	35	58	65	49
No	56	46	55	65	42	35	51
Major loan sources (%)	100	100	100	97	99	100	97
NGOs	46	12	4	15	10	9	15
Purpose of loan (%)							
Business	46	12	4	15	10	9	15
Agriculture	36	30	53	52	56	57	48
Livestock	8	17	4	–	1	6	7
Others (marriage, sickness, house construction, etc.)	10	41	39	33	33	28	30
Desire to have a loan (%)							
Yes	67	59	47	42	70	54	59
No	33	41	53	58	30	46	41

Table 4.7 Forest products extraction by household members

Variable	Range		Whole CWS
	Chunati	Jaldi	
Frequency of entry/month	14.45 (79 %HH)	15.18 (78 %)	14 (78 %)
Time (hrs) spend/visit	5.5	4.9	5.2
Products collected/month			
Fuelwood (kg)	84 (61 %HH)	41 (61 %)	63 (61 %HH)
Leaves (kg)	26 (68 %HH)	19 (71 %)	23 (70 %)
Timber (cft)	2 (0.66 %HH)	2 (0.65 %)	2 (0.65 %HH)
Sungrass (bundle)	2 (39 %HH)	2 (41 %)	2 (40 %HH)
Broomsticks (bundle)	3 (59 %HH)	4 (66 %)	4 (63 %HH)
Market price (BDT) of extracted products	3,266	5,504	4,385

4.4.2 Dependency of Local People on the CWS

4.4.2.1 Forest Products Extraction by the Sampled Households

It was observed that nearly 80 % of local population collects forest products from the CWS both for personal consumption and for sale in the markets. During household survey, about 80 % of the respondents said that they visit CWS about 14 times per month for forest products collection (Table 4.7). In each visit, they spend more than five (05) hours and extract available products. As per their responses, more than 60 % of them collect fuelwood from the CWS. They use two categories of materials as fuel such as wood/stem/twigs and leaves. Children and women collect leaves and twigs from forest about 4–5 miles away from their houses. They collect leaves 20–25 days/month, and in a day, they can collect 1–2 bags (10–20 kg). But wood/timber/twigs are collected by man from deep forest 10–20 days/month and per day 2 bundles containing 20–30 kg/bundle.

They collect sungrass once a year, 4–6 bundles whose market value is BDT 150–200 per bundle. Broomsticks are collected twice or thrice in a year for their own use, and the market value is BDT 50–100. About 30–50 % men collect bamboo from deep forest for the purpose of sale. They earn BDT 400–600 per day selling bamboo. About 2–3 % of their collected bamboo is used for their own usage. Respondents reported that they use most of the collected products (70–80 %) for household consumption and only quarter amount is sold in the markets.

4.4.2.2 Forest Products Collection by the Local People (Forest Trails Survey)

In a one-day survey in 21 trails, we counted 1123 persons (187 in Chunati and 936 in Jaldi range) entered into the CWS for forest products collection (Table 4.8). In Chunati, we informed FD staff before conducting trail survey and sought their

Table 4.8 Forest resources collection by local people in the CWS

Variable	Range		Whole CWS
	Chunati (9 trails)	Jaldi (12 trails)	
No. of persons entering into the forest on the studied day	187	936	1123
Entry as individual (%)	36	75	56
Entry as group (%)	64 (2–6)	25 (2–14)	44
Male collector (%)	49	60	55
Female collector (%)	51	40	45
Frequency of entry/week	7.6 (1–8)	6 (1–10)	6.8 (1–9)
Time of entry	(7.00–10.30) am	(7–10.30) am	(7.00–10.30) am
Time of return	(2.00–5.00) pm	(2.00–5.00) pm	(2.00–5.00) pm
Quantity of extracted forest products (kg) on the studied day	5,657	20,720	26,377
Market price of collected products (BDT)	11,885	1,83,013	1,94,898
Quantity of extracted forest products (kg)/person	60	22	41
Market price (BDT)	127	194	160
Products collected	Dry and greenwood, twigs, leaves, poles, logs, bamboo, house broom, sungrass, etc.		

assistance. In fact, we were told that the FD staff members warned local people not to go to the CWS on the survey day. We assume that due to that reason, we noticed less number of local people entering into the forest of Chunati range. Another reason we were told is that during the survey period (November–December 2012), there were job opportunities in nearby agricultural fields and local people were employed in agricultural jobs.

Of the total people, 64 % in Chunati entered as group, while in Jaldi 75 % entered as individual. The number of male and female collectors was almost same in both sites. Local people collect forest products almost every day, and some of them reported that they even collect two times in a day. Children (8–12 years of age) and older women collect leaves and twigs, while middle-aged (20–45 years of age) males collect fuelwood, sungrass, bamboo, and timber/poles. All of them collect broomsticks in varying quantity.

Those who collect sungrass, broomsticks, bamboo, and logs usually start their traveling early in the morning (7 am). Women and children were found to enter a bit later into the forests till 10:30 am. Fuelwood collectors start to return with head or backloads at around 2 pm, but sungrass, bamboo, and broomstick collectors return in the afternoon and even in the evening. When we combined and quantified all products, we estimated 5,657 and 20,720 kg of forest products was extracted in Chunati and Jaldi range, respectively, summing up an amount of 26,377 kg in the whole CWS. Based on collectors' and guides' opinions, the estimated market price

Table 4.9 Products extracted from CWS found in trail survey

Product	Quantity	Unit price (BDT)	Total price (BDT)
Sungrass	318 bundles	220	69,960
Broom stick	190 bundles	325	61,750
Leaves and twigs	265 bags	20	5,300
Fuel wood	5632 kg	4	22,528
Log/timber/poles	99 logs	250	24,750
Bamboo	229 (No.)	10	2,290
Moida	52 (bundle)	160	8,320
Total			194,898

of all collected products was BDT 194,989. Each collector on an average earns BDT 160 per day.

If we consider products type, it can be observed that the dominant products local people usually extract include sungrass, broomstick, and fuelwood (Table 4.9). November through January is the harvesting time of sungrass, broomstick, leaves, and *moida*, and people collect fuelwood, poles, and bamboo round the year.

4.4.2.3 Betel Leaf Cultivation Inside the CWS

Local people living inside and adjacent to the CWS have been practicing betel leaf cultivation on forestland of the sanctuary for a long time. The land on which they cultivate betel leaf is government forestland. Some of the farmers have occupied the land, and many of them take lease from other encroachers. But all of them have to pay bribe to the forest department.

Betel leaf cultivation is a kind of shifting cultivation. Farmers cultivate betel leaf on a plot for 3–4 years and then shift to another area. They select bushy area near water sources. On an average, the plot size is 10 decimal. In March–April, just before the onset of raining, they prepare land and plant cuttings. In a plot of 10 decimal, they plant about 4000 cuttings. Farmers said that the cost of 1000 cuttings was BDT 1,800. Total cost including labor, fertilizer, shed, and other materials for a betel leaf plot is about BDT 15,000–20,000. Just after four months of planting, farmers harvest cuttings for sale. They can sell 1000 cuttings for BDT 16,000–21,000. After harvesting of cuttings, they allow the plants to grow for 2–3 years from which they pluck betel leaf for sale. From the sale of betel leaf, they can earn BDT 60,000–70,000 per year. In every year, they apply fertilizer (N, P at 1:2) 2–3 times along with cow dung. When productivity declines, farmers abandon the plot and left it for 3–4 years to grow bushes. After 3–4 years, they may return to the same plots or occupy fresh ones.

The staff members of the FD commented that they do not have any record on how many betel leaf plots are there in the CWS. Local people responded varying number of plots in the area. The members of survey team recorded 1594 betel leaf

plots in the whole CWS. The number of total betel leaf plots counted in different beats are 124, 221, 86, 292, 270, 504, and 97 in Chunati, Aziznagar, Harbang, Jaldi, Napura, Chambal, and Puichari beat, respectively. We do believe that the team members were not able to count 100 % of the total plots, but it can be assured that they counted at least 80 % of the total betel leaf plots. Total area with 1594 betel leaf plots covers about 65 ha. Local people reported that before bamboo flowering in 2007, there was more number of betel leaf plots in the CWS. When bamboo destroyed due to flowering, people had reduced betel leaf cultivation because they could not construct betel leaf shed without bamboo. Still, they purchase bamboo from outside to build betel leaf shed. As bamboo is growing now in the sanctuary, we can anticipate that people would increase betel leaf cultivation.

4.4.3 Land Uses and Forest Health of the CWS

4.4.3.1 Land Uses and Plantation Activities

Villagers reported that before declaring the Chunati reserve forest as CWS, it was a very deep forest. There were unaccountable numbers of big trees. They said the forest canopy was so closed that even at daytime, people could not see anything inside the forest. Many kinds of wildlife including elephant inhabited the area, and people feared to enter into the forest. Just before declaring as AP, influential people started felling the trees with passive support from corrupted forest officials. At the same time, when the then government promoted green revolution with the slogan of "No land can be left vacant, cultivate rice and be self-dependent," these influential people occupied deforested land and converted into agricultural land. The trend has been continuing since then which can also be evident if we see land uses in the CWS (Table 4.10).

The land-use data based on two satellite imageries (1989, 2006) indicate that only a fraction of the CWS (1.21 % in 2001) consisted of forest. Forest areas

Table 4.10 Table land-use classification of CWS based on 1989 and 2006 imagery (*Source* NSP 2008)

Land use	1989		2006		Change (%) between 1989 and 2006
	Area	%	Area	%	
Forests including plantations	172.77	2.06	101.71	1.21	(−0.85)
Grassland including bamboo	1666.82	19.84	773.09	9.21	(−10.63)
Grass–shrub	2833.62	33.73	2562.53	30.50	(−3.23)
Barren land	2889.17	34.38	4138.31	49.25	(+14.87)
Water	839.54	9.99	826.28	9.83	(−0.16)
Total	8401.92	100	8401.92	100	

Table 4.11 Plantation activities in the CWS (*Source* Chunati and Jaldi Forest Range 2011)

Fiscal year	Chunati range			Jaldi range		
	Core zone (ha)	Buffer zone (ha)	Total (ha)	Core zone (ha)	Buffer zone (ha)	Total (ha)
2002–2003	25.00	–	25.00	55.00	–	55.00
2003–2004	45.00	–	45.00	70.00	–	70.00
2004–2005	5.00	–	5.00	30.00	–	30.00
2005–2006	20.00	15.00	35.00	110.00	5.00	115.00
2006–2007	77.22	15.00	92.22	95.90	15.00	110.90
2007–2008	108.08	75.00	183.08	195.76	114.74	310.50
2008–2009	60.00	30.00	90.00	90.00	63.97	153.97
2009–2010	100.00	–	100.00	200.00	–	200.00
2010–2011	150.00	–	150.00	222.00	–	222.00
Total	590.30	135.00	725.30	1068.66	198.71	1267.37

including plantations, bamboo groves, and shrubs areas had decreased over 6-year period of time. As the forest was much degraded, then people exerted pressure on bamboo forest, and within this period, nearly 11 % bamboo groves were cleared. Although forest areas had decreased, barren areas had increased by about 15 %. These barren areas are mostly agricultural fields. Farmers cultivating these lands informed that they took lease from landlords. These landlords claimed that they own these lands, but FD staff members said these are forestlands.

We observed that villagers have also converted grassland into betel leaf plots and *Impereta cylindrica* plots (Shonkhola) for which they have to provide bribe to FD officials. Some influential villagers also established plantations mainly of *Acacia* species in degraded forestland inside the CWS. We found that these plantations were well protected and fenced, trees were growing well, and nobody can cut trees from these plantations. We were told they have to give bribe twice—at the time of planting and before harvesting. They supply fuelwood to nearby brick kilns from these plantations.

On the other hand, FD has also plantation programs (Table 4.11). Although there was no clear demarcation of core and buffer zone, plantations in the core zone include enrich plantations and in buffer areas SF plantations with CPG and VCF members. Due to proper maintenance, most of these plantations have been damaged and covered with weeds. FD staff members said that due to budget constraints, they could not perform post-planting management mainly of weeding.

4.4.3.2 Forest Health: Floristic Composition, Tree Stock, Structure, and Diversity in the CWS

The study recorded 93 tree species, 65 in Chunati and 78 in Jaldi range respectively, belong to 36 families (Table 4.12, Annex 4.1) including indigenous and planted and

coppice originating trees such as *Acacia* spp., *Acacia* hybrid, *Shorea robusta, Tectona grandis, Gmeilina arborea, Ficus* spp, etc. Among the families, Euphorbiaceae (8 species) and Mimosaceae (8 species) contain the highest number of species followed by Myrtaceae (7 species), Lauraceae (5 species), Moraceae (5 species), Verbenaceae (5 species), Rubiaceae (5 species), and Tiliaceae (5 species). Other families consisted of 1–3 species. In an evergreen forest in northeastern India, Tripathi and Tripathi (2010) recorded 76 tree species from 1 ha of sample plot. In a dry tropical forest of northern India, Sagar et al. (2012) identified 49 (dbh ≥ 10 cm) tree species in 24 plant families from 15 ha areas. On the other hand, Panda et al. (2013) had recorded 263 tree species from 222 ha areas in Eastern Ghat, India. Htun et al. (2011) identified 86 tree species in 1.68 ha sample area from Popa Mountain Park, Myanmar. In Bangladesh, Biswas and Misbahuzzaman (2008) recorded 66 tree species under 27 families from 2 ha sample plot of a subtropical reserve forest. In a wet evergreen forest of Chittagong, Feroz et al. (2014) identified 40 woody plant species.

In both ranges, *A. auriculiformis*, an exotic species in Bangladesh, was the dominant species which can be evident from the values of importance value index (IVI). The IVI values (Fig. 4.3) indicate that few dominant species have IVI values of more than 10 out of total 300. These species include *Acacia auriculiformis* (48), *Dipterocarpus turbinatus* (27), *Ficus hispida* (24), *Tectona grandis* (21), *Shorea robusta* (13), *and Acacia mangium*. Of these species, *D. turbinatus* and *F. hispida* were native species in the CWS. The IVI values indicate that the dominant species in terms of stock and yield (basal area) in the CWS consisted mainly of exotic species. These species do not produce any edible fruits or shoots for wildlife, and due to lack of food wildlife, most often enter into villages and damage agricultural produces. The villagers urged to plant more fruit trees in the CWS areas so that wildlife would get abundant food in the forests and would not destroy villagers' agricultural produces.

The vegetation survey found an average density of 239 trees/ha of which 60 % tree stock was composed of planted exotic species including *Acacia auriculiformis*

Table 4.12 Composition, stock, and diversity of trees in the CWS

Variable	Forest range			Whole CWS
	Chunati	Jaldi	Sig. level	
No. of species	65	76	–	93
Density (stems/ha)	295	197	$P < 0.282$	239
Basal area (m^2/ha)	2.54	2.42	$P < 0.643$	2.64
Biomass (ton/ha)	38.48	28.49	–	33.30
Recently felled trees (stump/ha)	202	101	–	148
Shannon–Wiener index	2.60	3.38	$P < 0.650$	3.15
Species diversity index	87.86	93.81	$P < 0.044$	121.26
Species richness index	19.70	23.46	$P < 0.0001$	26.11
Evenness index	1.43	1.80	$P < 0.769$	1.60
Index of dominance	0.18	0.06	$P < 0.354$	0.09
Disturbance index	0.22	0.15	$P < 0.05$	0.76

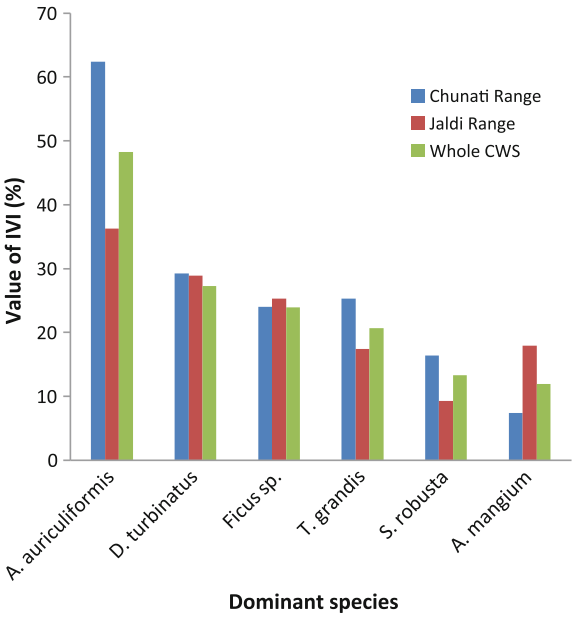

Fig. 4.3 Dominant tree species with their IVI values in the CWS

(26 %), *Acacia mangium* (6 %), *Acacia* hybrid (2 %), *Eucalyptus camaldulensis* (8 %), *Shorea robusta* (5 %), *Tectona grandis* (10 %), and *Gmeilina arborea* (3 %), and the rest 40 % stock (96 trees/ha) was composed of 86 species of which most of them were indigenous. Among the indigenous species, the following species had notable stock—*Ficus hispida* (8 %), *Trema orientalis* (2 %), *Firmiana colorata* (2 %), *Anogeissus acuminate* (2 %), and *Terminalia belerica* (2 %). Basal area and hence biomass production were very minimum, 2.64 m^2/ha and 33.30 tree/ha, respectively (Table 4.12), which were due to very poor growth of trees apparent from diameter distribution of trees (Fig. 4.4). There was no significant difference between two ranges regarding density, basal area, and biomass stock. When we estimated density in all seven forest beats, there was significant difference among the beats which was apparently due to higher density (498 trees/ha) in Chunati beat (Table 4.13). This higher density did not influence basal area and biomass production.

The Chunati range office is located nearby Chunati forest beat, and hence, the forest of Chunati beat is relatively well protected. This is the reason why the Chunati forest beat has the highest tree density. The mean basal area in the CWS is 2.64 m^2/ha, and there was no remarkable difference among the forest beats. The average biomass of the CWS is 33.30 tree/ha, and like basal area, there was no significant difference in biomass among seven forest beats (Table 4.1). In a tropical dry forest, Sultana et al. (2014) have found an average tree density of 1019 and mean basal area of 16.19 m^2/ha. In an evergreen forest in India, Tripathi and Tripati

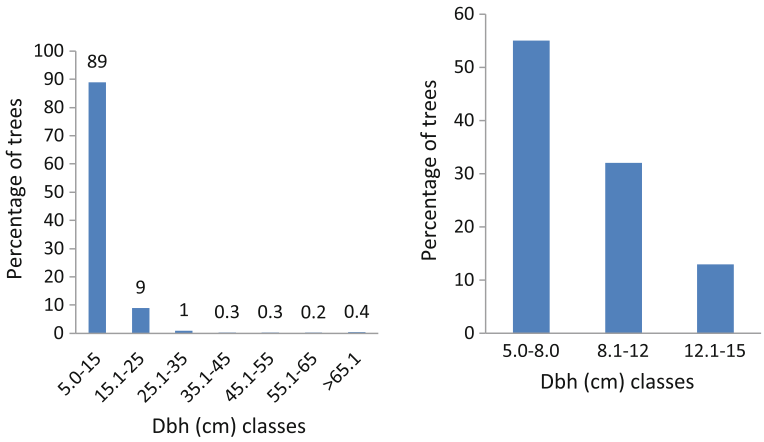

Fig. 4.4 Diameter at breast height (Dbh) distribution of trees in the CWS

Table 4.13 Composition, stock, and diversity of trees in different beats of the CWS

Variable	Beat name							Sig. level
	Chunati	Aziznagar	Herbang	Jaldi	Chambal	Napora	Puichari	
Species	45	42	33	44	47	41	47	–
Density (stems/ha)	498	243	169	204	131	256	196	$P < 0.01$
Basal area (m^2/ha)	2.16	2.27	2.24	2.13	1.96	1.45	2.22	$P < 0.62$
Biomass (ton/ha)	40.15	36.50	38.59	26.64	17.45	19.64	49.83	$P < 0.71$
Recently felled trees (stump/ha)	210	170	310	170	60	100	100	$P < 0.03$
Shannon–Wiener index	2.19	2.47	2.34	2.92	3.13	2.60	3.02	$P < 0.86$
Species diversity index	61.65	55.36	43.24	52.67	54.93	52.81	56.25	$P < 0.03$
Species richness index	14.68	15.26	12.65	16.46	19.02	14.77	18.45	$P < 0.01$
Evenness index	1.33	1.52	1.54	1.78	1.87	1.61	1.80	$P < 0.77$
Index of dominance	0.27	0.17	0.18	0.11	0.08	0.14	0.10	$P < 0.92$
Disturbance index	0.08	0.06	0.11	0.06	0.02	0.04	0.04	$P < 0.05$

(2010) reported a density of 1023 and basal area of 33.3 m^2/ha. Tadele et al. (2014) reported a basal area of 22.3 m^2/ha from a remnant montane forest in Ethiopia. In a disturbed tropical forest in northern India, the basal area and tree density were estimated 9.47 m^2/h and 572, respectively (Borah and Garkoti 2011). Tree species density varied from 604 to 975/ha and basal area from 17.8 to 37.8 m^2/ha in the three disturbed forest stands in Popa Mountain Park, Myanmar (Htun et al. 2011).

The state of basal area and biomass revealed that the trees in the CWS are smaller in diameter and this is apparent from diameter distribution (Fig. 4.4). The diameter class distribution shows that nearly 90 % trees belong to 5–15 cm dbh class and only one percent of trees belong to 25–35 cm dbh class. Of the 90 % trees in 5–15 cm dbh class, nearly 55 % trees are within 5–8 cm dbh. It indicates that very few big trees are present in CWS and newly emerging trees are occupying the forest. It was observed that about several hundreds of big *Dipterocarpus turbinatus* trees were kept protected throughout the CWS as mother trees for enhancing natural regeneration. The villagers reported that there were occasional incidences of illegal cutting of these protected trees. The diameter class distribution of trees also signifies that the forest is seriously degraded which is apparent from the availability of recently felled tree stumps. The study counted an average of 148 tree stumps/ha in the CWS (Table 4.12). The number of recently felled tree stumps was significantly highest in Herbang forest beat (310 stumps/ha) than that of other forest beats (Table 4.13). The disturbance index also signifies that Herbang forest beat is highly disturbed (disturbance index 0.11) than the other forest beats (Table 4.13). It reveals that Herbang forest beat is vulnerable to severe illegal logging of forest trees. During the study, it was observed and villagers and FD staff members reported that Rhuinga refugees from Myanmar have encroached forestland in Herbang and they are involved in illegal logging of forest trees to make their living.

The Shannon–Wiener index of the CWS was 3.15, and there was no significant difference among the forest beats (Table 4.12). The order of this index in seven forest beats was Chambal > Puichari > Jaldi > Napura > Aziznagar > Herbang > Chunati (Table 4.13). The similar trend was also observed for species richness index, but it was significantly higher in Chambal than the other forest beats. No significant difference was found for evenness index. The maximum evenness was for Chambal (1.87) and minimum for Chunati (1.33). The index of dominance of the CWS was 0.09 with minimum in Chambal (0.08) and maximum in Chunati (0.27). The Shannon–Wiener index of the CWS is reasonable when compared to dry deciduous forest of Rajasthan, India (2.44) (Sultana et al. 2014), and evergreen forest of Meghalaya, India (4.2) (Tripathi and Tripathi 2010). Feroz et al. (2014) reported the values of Shannon's index as 3.36 in a tropical wet evergreen forest of Bangladesh.

Tree composition, stock (tree density, basal area, and biomass), canopy coverage, and number of recently felled trees along distance gradient from boundary toward interior of the CWS were decreasing significantly (Table 4.14). The Shannon–Wiener index was significantly higher in 2001–3000 m distance gradient (3.39) and was lowest in 1001–2000 m distance gradient. Species richness index was significantly higher in 0–1000 m distance gradient (21.20), while evenness index was highest in 2001–3000 m distance gradient (2.01). However, no remarkable difference was observed for index of dominance.

We also categorized all sampled plots on the basis of forest types—natural forest, enrichment plantations, and newly established plantations. Floristically natural forests were rich (70 species), but heavily degraded which was evident from the lowest tree density (115/ha), basal area (1.35 m^2/ha), biomass production (24.66

Table 4.14 Composition, stock, and diversity of trees at different distance gradients in the CWS

Variable	Distance (m)				Sig. level
	0–1000 (N = 62)	1001–2000 (N = 37)	2001–3000 (N= 21)	3001–5300 (N = 20)	
Species	71	60	48	45	–
Density (stems/ha)	322	213	149	127	$P < 0.092$
Basal area (m^2/ha)	3.89	2.88	0.98	0.67	$P < 0.008$
Biomass (ton/ha)	49.19	32.13	9.01	7.28	$P < 0.038$
Canopy coverage (%)	53	46	40	30	$P < 0.039$
Recently felled trees (stump/ha)	220	160	140	100	$P < 0.497$
Shannon–Wiener index	2.89	2.65	3.39	3.22	$P < 0.007$
Species diversity index	93.94	77.25	53.72	50.94	$P < 0.0001$
Species richness index	21.20	20.35	18.84	18.29	$P < 0.0001$
Evenness index	1.56	1.49	2.01	1.95	$P < 0.001$
Index of dominance	0.12	0.16	0.05	0.06	$P < 0.881$

Table 4.15 Quantitative structure of tree species in CWS at different forest categories

Variable	Forest category			Sig. level
	Enrichment plantation (N = 26)	Natural (N = 76)	Plantation (N = 38)	
No. of species	62	70	44	–
Density (stems/ha)	255	115	473	$P < 0.0001$
Basal area (m^2/ha)	3	1.35	4.23	$P < 0.006$
Biomass (ton/ha)	41.16	24.66	43.13	$P < 0.002$
Canopy coverage (%)	46	24	55	$P < 0.0001$
Recently felled trees (stump/ha)	130	120	220	$P < 0.083$

tree/ha), and 24 % canopy coverage (Table 4.15). Although severely degraded, there was incidence of illegal cutting of trees in natural forests and we recorded 120 stumps per hectare and it was highest (220 stump/ha) in plantations.

4.4.3.3 Regeneration Status in the CWS

Regeneration study recorded 74 regenerating tree species under 31 families. Among the families, Euphorbiaceae (9 species) consisted the highest number of species followed by Verbenaceae (7 species) and Moraceae (5 species). Other families were composed of 1–4 species.

Table 4.16 Quantitative structure of some dominant regenerating tree species in CWS

Species name	Seedlings/ha	RD (%)	RF (%)	RA (%)	IVI (%)
Bambusa spp.	47,414	62.00	10.75	16.25	89.00
Ficus hispida	2,771	3.62	8.51	1.20	13.33
Tectona grandis	2,029	2.65	2.09	3.58	8.32
Chidion lanceolarium	1,729	2.26	3.53	1.80	7.60
Holarrhena antidysenterica	1,429	1.87	4.01	1.31	7.19
Tamarindus indica	300	0.39	0.16	6.89	7.44
Trema orientalis	1,143	1.49	4.33	0.97	6.80
Calamus spp.	1,471	1.92	2.25	2.41	6.58
Duabanga grandiflora	657	0.86	0.48	5.03	6.37
Dipterocarpus turbinatus	1,214	1.59	2.89	1.55	6.03
Grewia nervosa	914	1.20	3.05	1.10	5.35
Syzginm fruticosum	1,114	1.46	2.41	1.71	5.57
Lithocarpus acuminata	886	1.16	3.05	1.07	5.28
Total species: 74	76,471	100	100	100	300

Note RD relative density, *RF* relative frequency, *RA* relative abundance, *IVI* importance value index

The quantitative structure (Table 4.16) of regenerating tree species shows that the density of regeneration was 76,471 seedlings/ha of which *Bamboo* spp. contained 47,414 culms/ha, 62 % of total regeneration. The IVI value also indicates bamboo (IVI = 89 %) was dominant. Other dominant species were *Ficus hispida, Tectona grandis, and Glochidion lanceolarium*. Regeneration of *T. grandis* was accounted by counting the number of coppice shoots.

4.4.4 Governance Structure and Functionality of Co-management Approach at Local Level

The central objective of NSP was to develop a formal collaborative governance model for forest protected areas. After long debate and negotiations a governance structure was developed that included a broadly representative co-management council of maximum 65 members including 15 women members drawn from all walks of life around each PA and a smaller executive co-management committee (CMC) consisting of maximum 29 members including five (05) women elected from the members of this council (Box 4.1). The co-management council lasts for maximum four (04) years and the CMC for two (02) years.

Box 4.1 Structure of CMC in PA co-management (*Source* MOEF 2009)

Co-Management Council and Committee Structure, 2006

Co-Management Council Structure

1 Upazila Nirbahi Officer (UNO) - Chairperson
1 Assistant Conservator of Forest or Range Officer – Member-Secretary
9 Representatives from the organized poor
13 Chairmen and members from relevant Union Parishads and Pourashava (closest wards to PA, at least 1 woman)
9 Representatives of poor resource users
6 Representative from resource owners (brickfields, sawmills etc)
3 Representatives from ethnic minorities
2 Representatives from local youth
6-8 Representatives from local elite
1 representative of other major stakeholders
1 Representative from law enforcing agencies
4-6 Representatives from other Government agencies
2-4 Representatives from local NGOs
Relevant Member of Parliament to act as Advisor
Maximum 55 members, including 10 women.
Term of those not officials or elected, 4 years.

Co-Management Committee Structure

1 Assistant Conservator of Forest or Range Officer - Member-Secretary
3-4 Representatives from local government (UP) (1 woman)
2-3 Representatives from civil society
2 Representatives from resource user groups
1 Representative from local youth
2 Representatives of resource owner group
2 Representatives from ethnic minorities
1 Representative of law enforcing agencies
2 Representatives from other Government agencies
1 Representative from NGOs
Upazila Nirbahi Officer (UNO) - Adviser

President and Vice-President to be elected by Committee members from among their membership. Term of office 2 years except for Member-Secretary and law enforcement agency representative

The co-management approach, structure, and functions of CMC were endorsed by a government order in November 2009 (UNDP 2013). The CMC had been empowered with several functions including liaise with FD, distribution of proceeds among management groups, support FD in employing labor, develop and submit projects for funding, making work plan, maintain accounts, initiate patrolling of PA and resolution of conflicts (Box 4.2).

The participatory governance imperative in PA co-management has been accomplished through the formation of a co-management committee and council, village conservation forums, and people's forums (UNDP 2013). In CWS, we observed a four-tier governance structure (Fig. 4.5). This structure shows that an endogenous platform has been formed for the co-management of CWS with each component of the structure having their own functions. Here, we discuss function of co-management structure at local level in CWS.

Discussion with IPAC staff members and synthesis of its project reports reveals that there are 60 village conservation forums (VCF) in CWS. There are 34 VCF (1810 members) and 26 VCF (1485 members) in Chunati and Jaldi ranges, respectively. Both males (2694 members) and females (601 members) are included in VCF. Although IPAC staff members and documentary records show 60 VCF, we felt that the existence of VCF at field level is a little obscure. We did not find the list of members, and when we contacted leaders of some VCF, they said that they were not sure whether they were really leaders or not. They did not know how the VCF

Box 4.2 Functions of co-management council and committee in PA management (*Source* MOEF 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.

was formed and what were the functions of VCF. During our field studies, we did not observe any activities of VCF in the management of CWS. However, UNDP (2013) reported that by involving VCFs in a range of governance and volunteer activities, the initiative has encouraged responsible citizenship and increased the resilience and unity of the communities it serves. The UNDP also stressed that VCF address the management of natural resources in their particular area.

Each people's forum (PF) consists of two members, one male (leader of respective VCF) and one female. The purpose of PF is to feed VCF's concern and needs onto CMC. When invited by CMC or IPAC, they attended at meetings, but did not feed any concerns. The reason as they mentioned is that the VCF itself did not organize any meeting to discuss their needs and aspirations.

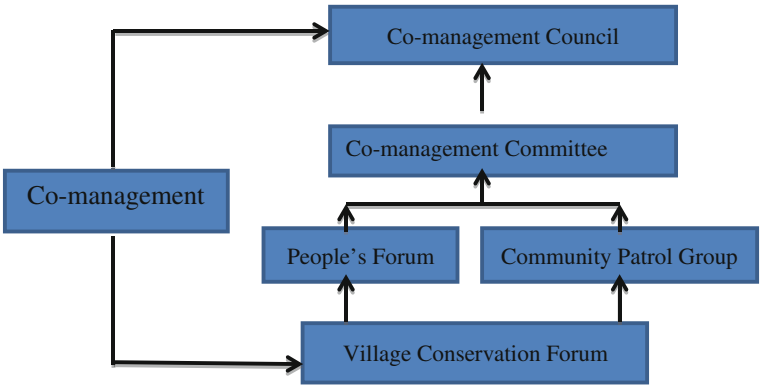

Fig. 4.5 Co-management structure at CWS

The members of community patrol group (CPG) in collaboration with FD patrol forest in their respective areas. Members of each CPG were divided into several subgroups containing six persons in each subgroup. Of these six persons, three of them patrol in daytime and another three persons in nighttime along with three forest guards. However, the female CPG members patrol forest with FD staff and male CPG members in the morning and in the afternoon. Even when they heard that people cut trees at night, the CPG members with FD staff rushed to the spot to protect forest. During group discussions with CPG members, they commented that due to their almost voluntary patrolling, illegal cutting of trees had been reduced.

They said "if the illegal tree fellers see the CPG members with IPAC dress, they [illegal loggers] feel that FD staff is coming and so get fear to cut trees." They also claimed, "we always protect the forest. The officers who stay in city do not protect the forests." UNDP (2013) reported that although the CPG members have not completely stopped illegal logging in the CWS, their work has resulted in a considerable reduction of timber poaching. However, forest patrol by CPG also created conflict with FD and illegal loggers. The CPG members commented that due to the existence of CPG, FD staff members do not get endowment from private plantation's holders. Forest patrolling reduced the incidence of illegal tree cutting and at the same time illegal income of FD staff and that is why FD staff members do not cooperate with CPG.

At the beginning, all CPG members worked properly, but now many of them have become inactive. Nowadays, they do not patrol like earlier. However, illegal loggers do not cut trees due to the fear of CPG members. Based on IPAC reports and talk to CPG members, we found that 238 members out of 540 have become inactive, and some of them have died. We explored what were the reasons for joining and quitting from CPG. The NSP and consequently IPAC have motivated them to join as members of CPG with some promises. Some of the promises included:

> If you conserve the forest God will bless you, your children will get O_2, and Germany will buy CO_2 because this country produces more CO_2. You will get salary from July 2011 from C-trading. If there is no forest, the area will be desert and you cannot grow rice in agricultural land.

They also promised that CPG members will get BDT 5000 for purchasing cattle/rickshaw or for capital investment in business. They will be provided training, employment, social forestry (SF) plots for plantation establishment, and support for alternative income generation (AIG).

All CPG members were provided with uniform, shoe, a torch, and an umbrella. We found that all members did not get BDT 5000. Women CPG members said that they got BDT 3500 and many male members got only BDT 2000. The NSP and IPAC conducted several training programs including livestock rearing (1 day), fish farming (1 day), and tourism (7 days) for male CPG members. The women CPG members participated in training on improved cooking stove (ICS, 7 days), boutique (21 days), vegetable farming (1 day), and nursery raising (3 days). However, all male and female members did not get opportunity to participate in trainings. Male members reported that training was not fruitful for them because they could not apply the knowledge due to lack of capital. Many women CPG members got ICS and commented that the use of ICS helped to save fuelwood, their kitchen remain clean with no smoke, and crockeries do not damage quickly. They get loan from NGOs and invest in boutique and nursery establishment. Both male and women CPG members claimed that they need AIG. They said that they heard many AIG projects such as fish farming, poultry, and livestock had come, but they did not get any benefits. A fish farming project was initiated with 30 CPG members in 2009. But it was not successful because the selection of pond site was not appropriate and pond banks were broken.

All CPG members did not get land for SF plantations. Although all members of some CPG got SF plots, in most of the CPG only 40–50 % members got SF plots. Some members got 2 ha of land and other only 0.5 ha. They claimed that many outsiders who are not members of CPG and rich people got SF plots because they have good connection with FD staff. They also commented that FD staff got an endowment of BDT 3000–5000 from those people. Women CPG members did not get SF plots yet. They reported that FD wanted to give plots to only eight (08) members, but they did not accept FD's offer and claimed plots for all members.

FD has raised SF plantations and made decision on species composition. The composition was 50 % fast-growing exotic species and 50 % native species. FD staff said that fast-growing exotic species can grow in adverse conditions, whereas native species die if timely silvicultural operations are not done. When senior officials visit the site, they can show the performance of exotic species. However, CPG members said that they would like native species which provide fruits for wildlife. Some plantations were located faraway from member's settlement although non-CPG members got near their locality. CPG members said that most of the plantations were poorly stocked because they could not take proper care and illicit fellers cut many trees. FD decides to whom and where to allocate land for SF. CPG members do not have way to protest FD's decision.

The rotation of SF plantations was 10 years, and if the plantations had more than 40 % trees, then the plot would be allocated for SF for another 10 years. So, CPG members could raise plantations for three rotations (30 years). They are not aware what will happen after 30 years. They are also not aware of benefit sharing of SF plantations. Some of them said that benefits from SF harvest will be distributed as 40 % member, 40 % FD, and rest 20 % for tree fund. Others said the ratio would be 60, 30, and 10 %, and even some others said the ratio as 45, 45 and 10 %. However, members will get all benefits from thinning (at 4 and 7 years) of plantations. Therefore, it seems that there was a gap between CPG member's aspirations and real achievements and that is why many of them have quitted. They commented, "we got hope, still have hope and that's why working to protect the forest."

The CMC in Chunati was founded with the main goal of conserving CWS in collaboration with local communities and government agencies acting as a supporting role (UNDP 2013). It functions with a high level of cooperation and mutual respect between its members (ibid.). However, our observation does not fully support UNDP's findings. Although CMC has member secretary from FD and civil society members, people believe that CMC means its president and vice president. The CMC as body does not have very active role in making any management-related decisions. They said that when needed, the NSP and IPAC staff members consulted for approval of any decision they took beforehand. CMC itself does not call any meetings. NSP or IPAC usually organize the meetings and invite all CMC members to attend the meetings. Meeting's agenda, minutes, and budgets all are handled by NSP or IPAC. The chairman of CMC said that they do not have any fund. The current activities of CMC are being managed by IPAC. The CMC members wonder how they would manage office work when project funding ends.

Although CMC is a part of FD as per government order 2009, however, staff of FD feels that CMC is an outside organization, and as such, they lack mutual understanding. It is partly because of lack of knowledge of FD staff. One staff member of FD said that he did not have any idea of co-management before joining at Chunati range, and now he understood the concept nevertheless at the moment of his transfer from Chunati. There was lack of coordination among FD, IPAC, and other CMC members. The president of CMC said that they decided to prepare a lake in the CWS for fish farming by involving CPG and VCF members. However, staff of FD did not allow as the lake would be inside the CWS. In another example, IPAC supplied vegetable seeds for home gardening to villagers who have been living inside the CWS. Staff of FD commented that where would the villagers cultivate vegetables? Some staff members said that after project funding period, who will provide the support to villagers? It means that when IPAC or CMC members take any decisions, they did not invite FD staff members, and hence, there was misunderstanding among them.

The CPG members showed their dissatisfaction on CMC. They claimed that CMC hold meetings, but no information passed onto CPG members. They do not know what CMC was doing. They do not have faith in CMC and FD staff because:

> Four years before CMC said that they will give SF plots to CPG members. Only few of us [CPG members] got plots. What's wrong with other members? Forest ranger said to be patient, all of you [CPG members] will get plots.

4.4.5 Co-management and Forest Conservation

Although there were some limitations in co-management governance, this new management approach has brought positive changes in forest conservation. The CPG members and other stakeholders said that before co-management project, the CWS looked like a desert, and they could not get any shade. They could see wildlife very rarely. Due to NSP, forest coverage has increased by 80 %. The whole CWS looks like a deep forest even though there are not many big trees. Nowadays, they often see elephant, deer, bear, and other animals. Elephants damage rice field and young plantations, and sometimes they kill humans too. The co-management also created some very latent conflict. Due to the existence of CPG, FD staff members do not get endowment from private plantation holders. There are many private plantations in the CWS. Due to patrolling, illegal cutting of trees reduced, and at the same time, illegal income of FD staff members has also reduced. That is why FD staff members do not cooperate with CPG. Creation of CPG has created this hidden conflict among CPG–FD–illegal loggers.

4.4.5.1 Peoples' Knowledge and Opinion on Forest Conservation

The co-management project through motivation and awareness creation campaigns has improved people's understanding of biodiversity, climate change, and their impacts. We asked respondents to know their knowledge about biodiversity, present biodiversity conditions in the CWS, their perception on climate, and impacts of climate change in their life. We also gathered information on the respondent's opinion on the protection of CWS and actions needed for CWS protection. The findings are described below.

About 62 % respondents across three categories reported that they heard the term "biodiversity" (Table 4.17). By the term "biodiversity," they meant a variety of plants and animals living in the CWS. More than 80 % respondents reported that they knew positive impacts of biodiversity. They commented that biodiversity provides them many goods (fruits, vegetables, fuelwood, medicine, etc.) and services (water, pure air, shade, windbreak, etc.) in meeting their daily needs. Forty-six (46) percent of local population (control members) in both Chunati and Jaldi ranges reported that they do not know about biodiversity.

Except control members, more than 80 % respondents reported that biodiversity situation in the CWS has been improving (Table 4.17) due to conservation efforts by Nishorgo and IPAC projects and protection by the CPG members. They said that

Table 4.17 Respondents' knowledge on environmental education and awareness

Variable	Chunati range			Jaldi range			Whole CWS $N = 829$
	CPG ($N = 208$)	VCF ($N = 184$)	Control ($N = 101$)	CPG ($N = 94$)	VCF ($N = 142$)	Control ($N = 100$)	
Know about biodiversity (% of participants)							
Know	73	71	62	53	50	39	62
Do not know	27	22	26	29	38	56	30
No comment	–	7	12	18	12	5	8
Present CWS biodiversity condition (% of participants)							
Increasing	91	89	64	86	80	67	83
Decreasing	9	5	21	3	18	27	12
No comments	–	6	15	11	2	6	5
Have idea about climate changes (% of participants)							
Yes	68	53	42	48	34	28	50
No	32	36	25	31	53	67	38
No comments	–	11	33	21	13	5	12
Impacts of climate change (% of participants)							
Negative	59	60	48	48	65	42	53
Positive	26	20	17	21	15	12	19
No comments	15	20	34	31	20	46	28
Need to protect CWS (% of participants)							
Yes	100	100	97	100	97	98	99
No	–	–	1	–		–	–
No comments	–	–	2	–	3	2	1
Actions needed for the protection of CWS (% of participants)							
Awareness	83	80	70	73	75	68	73
Participation	85	77	65	71	76	70	74
Patrolling	80	78	66	71	71	66	72
Financial support	68	54	56	50	45	48	53
Plantation	76	80	77	71	78	80	76
Land distribution	48	50	45	57	44	36	46
Reduce corruption	56	50	61	50	45	35	48

due to protection, remaining forests are growing well and natural regenerations are coming out. Due to reduction of illegal felling and regular patrolling by the CPG members, forests become dense. Respondents commented that because there were little disturbances in the forests, the number of wildlife, mainly elephant, deer, and monkey, had increased. They said that they can see elephants nowadays frequently, which was not possible in last five years.

Nearly 70 % CPG members of Chunati mentioned that they were aware about climate change. Across three categories, 50 % respondents reported that they had idea about climate change. Fifty-three (53) percent of respondents pointed out some negative aspects of climate changes. For example, due to forest loss, the weather becomes warm, temperature of the surroundings had increased, rainfall became irregular, and frequency of drastic cyclones had increased. They also commented that forests can capture more carbon from atmosphere and the developed countries like Germany would buy carbon from them, and thereby, they would economically be benefited. Seventy-three (73) percent of local population (control members) commented that they did not have any idea about climate changes.

For biodiversity conservation and protection of their local heritage, almost 100 % respondents (Table 4.18) across all CPG, VCF, and control said that they need to protect the Chunati Wildlife Sanctuary. They feel that through the resources of this sanctuary, people of the country and abroad can know them and their locality. They would feel proud of this CWS if visitors come to visit the area.

Respondents mentioned some actions that might be needed for the protection of the CWS. These were creation of awareness (>75%) among the local people of the importance of CWS and its biodiversity for their livelihood, active participation of local people (>70 %) in the management of CWS, patrolling (>70 %) for controlling illegal cutting of trees, monetary help (>50 %) for alternative income

Table 4.18 Respondents' opinion on trends of resource availability in CWS area (values are average of the following scale: 1 = very bad, 2 = bad, 3 = good, 4 = very good, 5 = excellent)

Variable	Chunati range			Jaldi range			Whole CWS $N = 829$
	CPG ($N = 208$)	VCF ($N = 184$)	Control ($N = 101$)	CPG ($N = 94$)	VCF ($N = 142$)	Control ($N = 100$)	
Forest resources availability in last 5 years							
Timber	2.7	2.3	2.8	2.4	2.6	2.5	2.6
Fuel	2.7	2.5	3.1	2.4	3.1	3.2	2.8
Bamboo	2.1	2.6	2.9	2.8	3.1	3.2	2.9
Medicinal plants	2.4	2.2	2	2.6	2.6	2.1	2.6
Current forest resources availability							
Timber	3.3	2.9	2.8	3	2.7	2.6	3
Fuel	3.1	2.9	3.1	3	3	2.7	3
Bamboo	2.1	2	2.2	1.7	2.2	2.1	2.1
Medicinal plants	2.9	2.4	2.1	2.6	2.4	1.8	2.7
Future forest resources availability							
Timber	3.9	4.1	3.9	3.9	3.4	3.1	3.8
Fuel	3.7	4.1	4.1	3.8	3.6	2.9	3.8
Bamboo	3.3	3.8	3.6	3	3.2	2.9	3.4
Medicinal plants	3.5	3.3	2.7	3.3	2.8	1.9	3.4

generation, thereby reducing people's dependency on forest resources, and reforestation (>70 %) for increasing forest coverage. Some respondents (<50 %) mentioned to distribute vacant forestland in the periphery to the local people for plantations. Some of them (35–60 %) also commented to reduce corruption of the officials who were involved in forest management.

Social forestry can play an important role in meeting demand of fuelwood in the locality. Buffer zones of the CWS can be brought under social forestry programs. Respondents had previous experience about social/community forestry. They had participated in community forestry projects implemented earlier in their areas. When asked, more than 75 % CPG members in both Chunati and Jaldi forest ranges mentioned that they knew goals and objectives of community forestry. However, most of the VCF and control members did not have any idea about community forestry. It was possible that they were not involved in community forestry earlier, and CPG members who were more dependent on forests for their livelihood had been involved in community forestry. Continuation with community forestry, we asked whether they would like to join the community forestry in the near future. More than 96 % of them reported that they were interested in joining future social forestry project.

We also examined resources trends in the CWS based on respondent's perception. Based on a five-point scale [1 = very bad through 5 = excellent] used, we found that timber availability in the last five years was in between bad and good (mean value 2.3–2.8). In case of fuelwood, the figure was 2.5 to 3.2 (Table 4.18). Due to conservation efforts by Nishorga and IPAC projects, resources situation had improved which was evident from respondent's opinion on current forest resources availability (Table 4.18). They also commented that if further reforestation and protection measures would take place, then the forest resources availability would be much better. Their opinion indicated that availability of forest resources in the future would be in between good and very good.

4.4.6 A Comparison Between Baseline and Final Evaluation Data

The GIZ funded "Management of Natural Resources and Community Forestry Project" in Chunati Wildlife Sanctuary (CWS) implemented a number of programs including livelihood improvement of local people, forest patrolling, reforestation and awareness creation among local communities. Table 4.19 shows the changes in the CWS areas due to these programs. There have been positive changes in income enhancement through alternative income generation activities including livestock rearing, gardening, small business, and other options. The positive changes were also observed in case of reduction of betel leaf plots inside the CWS, cattle grazing by local population, forest resources collection, and awareness creation among local people about the importance of forest biodiversity and climate change knowledge. However, illegal felling of trees was continued as evident from reduction in tree density and increase in tree stump number.

Table 4.19 Impacts of GIZ projects on selected variables in the CWS

Variable	Baseline value (2012)	Final evaluation value (2015)	Comment
Mean household income (BDT/month)	5617	8603	+ change
Tree density (No./ha)	239	198	− change
Native tree density (No./ha)	96	143	+ change
Tree stump (No./ha)	153	168	− change
Cattle grazing (% of households)	96	61	+ change
Betel leaf plots (No.)	1594	1084	+ change
Persons collecting forest products per day (No.)	53	17	+ change
Peoples' awareness about biodiversity and climate change (%)	41 %	79 %	+ change

4.5 Concluding Comments

Since its declaration, the Chunati Wildlife Sanctuary has experienced serious threats from several corners. Thousands of local poor people depend absolutely on forest products of CWS for their living. Forest trails survey showed that hundreds of people enter into the CWS for extraction of forest products. A number of brick industries have been established in adjacent to CWS and illegal logger supply fuelwood to these industries from CWS. The forest areas have been fragmented and converted into other land uses including agriculture, betel leaf, sungrass field, private plantations, fruit gardens, and houses. Many settlements have been established inside the CWS. We were informed that local influential persons some of whom are also involved in CMC have encroached large tract of forest areas. However, they claimed that these are their own land. On the other hand, FD staff said they have filed cases in courts to solve these land disputes.

The forest structure of CWS has shown that these forests have been under manifold pressures. Reforestation initiatives by the forest department have failed due to lack of post-planting maintenance. Moreover, planting exotic plant species in CWS would jeopardize the objectives of biodiversity conservation. The values of tree density and basal area in the CWS are far below than those of tropical forests in neighboring countries. However, the species composition and diversity indices are comparable with other tropical forests. This indicates that even though the forest in CWS has been degraded severely, it harbors a diversified plant species. The interior parts of the CWS were severely degraded as evident from the lower stock and higher number of recently felled stumps in the inner region of forests. The natural regeneration counts, composition, and density reveal that the forests still have revival capacity and variety of trees have been growing from seeds and root suckers.

Co-management of forest PA is a recent forest management approach in Bangladesh. This approach has brought several positive changes in CWS

management. The changes include the development of a co-management governance structure, involvement of poor forest-dependent people in CWS management, creation of awareness among local people for the conservation of CWS, and provision for alternative income generation activities through direct support and training. As DeCosse et al. (2012d) said, development of a co-management governance structure was not an easy task, especially with the FD where the officials have been bearing a traditional top-down mind-set of forest management for a long time. Thanks to NSP and IPAC, the PA management in Bangladesh has got a paradigm shift of PA governance which has been formalized with a government order in 2009. However, development of a governance structure itself is not enough for effective management of natural resources unless it works properly.

The concept of co-management indicates that all stakeholders involved in resource management should effectively take part in making any decision related to planning, designing, implementing, and monitoring. The study found that actors (VCF, CPG, PF, and CMC) in the governance structure were engaged very passively in making managerial decisions which had created misunderstanding with FD, IPAC, and NSP. The CMC is a part of PA management entity which the FD staff members are still confusing, and hence, they [both CMC and FD] do not collaborate willingly for CWS management. FD staff at local level feels that it is a kind of punishment posting, and hence, they try to transfer to other places from the very beginning. As a result, they remain uninterested to understand about co-management and do not effectively collaborate with CMC.

Members of CPG whose functions were very crucial for the reduction of illegal cutting of trees have dissatisfaction with IPAC, CMC and FD members. The main reason was that the CPG members did not get as much benefits as promised by IPAC, CMC, and FD. Moreover, whatever benefits (e.g., project money, SF plantation plots, and training) provided to them were not distributed equally. As a consequence, many of them have become inactive and do not participate in forest patrolling. Even though there were several limitations, forest conditions have improved in terms of coverage, stock, and natural regeneration. Movement of elephants and other wild animals has increased, and villagers said that wild animals damage their agricultural produces and even kill human too. Wildlife–human conflicts have created negative impressions among villagers about co-management of CWS. They argued that they contributed to forest protection, but wild animals destroy their assets.

The project funding period of IPAC ends in the middle of 2013, and a new project funded by German International Cooperation would operate community forestry and livelihood development activities till 2014–2015. These development projects have helped to establish a management structure, but for the continuation of co-management functions, capacity building and self-reliance of stakeholders (CMC and FD) are indispensable. We would recommend the following policy implications for sustainability of co-management of PA in CWS:

(i) The FD should hold co-management concept as its own management approach of PA management and as such should consider CMC a supporting hand. Any decision regarding CWS management and socioeconomic development of forest-dependent villagers should be taken jointly by the CMC and FD. Representatives of CPG, VCF, and PF should be encouraged to attend CMC meetings.

(ii) FD should take steps for allocation of SF plots to those CPG members who have not got plots yet. For effective management, SF plots should be given near to their settlement.

(iii) Members of CMC work voluntarily. Although CPG members got some benefits, a continuous support is needed to endure their activities. Being a protected area, community-based ecotourism can be developed in CWS. Facilities for tourists such as lodging and refreshment are essential. Revenue earned from ecotourism can contribute to manage CMC's office works. When ecotourism develops, small village business would flourish and villager's economy would improve.

(iv) There are many lakes in the CWS which can be collectively managed for fish farming by VCF and CPG members. The revenue earned from these lakes can fairly help to boost rural economy.

(v) It is not easy to recover encroached forestland from the influential people. Local respectable and influential persons are the members of co-management council and CMC. The FD, co-management council, and CMC jointly can help to mitigate land disputes in CWS.

(vi) Thousands of villagers are engaged in, and huge transactions are associated with betel leaf cultivation. So it cannot be stopped suddenly. They can be involved in collective fish farming in the lakes available inside the CWS and be motivated to give up betel leaf cultivation gradually.

(vii) Privately established plantations in CWS should be identified and brought under mutually agreed benefit-sharing mechanism where both FD and planters (who established plantations) will get revenue share.

Annex 4.1 List of tree species recorded in the Chunati Wildlife Sanctuary (CWS)

Sl. No.	Family	No. of Species	Local name	Scientific name
1	Ulmaceae	1	Naricha	*Trema orientalis* (L.) Blume
2	Caesalpiniaceae	1	Amoossa	*Amherstia nosilis* Wall
3	Anacardiaceae	2	Am	*Mangifera indica* L.
			Uriam	*Mangifera sylvatica* Roxb.
4	Apocynaceae	3	Chatim	*Alstonia scholaris* (L.) R. Br.
			Kuruk	*Holarrhena antidysenterica* (Roxb. *ex* Fleming) Wall. *ex* A. DC.
			Moch	*Brownlowia elata* Roxb.
5	Thymelaeaceae	1	Agar	*Aquilaria agallocha* Roxb.
6	Bignoniaceae	3	Cilana	*Oroxylum sp.*
			Dharmara	*Sterospermum personatum*
			Kanaidinga	*Oroxylum indicum* Vent
7	Bombacaceae	2	Bontula	*Ceiba pentandra* (L.) Gertn.
			Simul	*Bombax ceiba* L.
8	Caesalpiniaceae	2	Minjiri	*Senna siamea* (Lam.) H.S. Irwin & Barneby
			Sonalu	*Cassia fistula* L.
9	Combretaceae	4	Arjun	*Terminalia arjuna* (Roxb. *ex DC.*) Wight & Arn.
			Bohera	*Terminalia bellirica* (Gaertn.) Roxb.
			Horitaki	*Terminalia chebula* (Gaernt.) Retz.
			Sheori	*Anogeissus lanceolate* (Wall. *ex* C.B. Clarke) Prain
10	Dilleniaceae	1	Hargoja	*Dillenia pentagyna* Roxb.
11	Dipterocarpaceae	4	Boilam	*Anisoptera scaphula* (Roxb.) Pierre
			Garjan	*Dipterocarpus turbinatus* Gaertn.
			Sal	*Shorea robusta* Gaertner f.
			Telsur	*Hopea odorata* Roxb.
12	Ebenaceae	2	Bilati Gub	*Diospyros blancoi* A.DC.
			Tomal	*Diospyros montana* Roxb.
13	Elaeocarpaceae	2	Jalpai	*Elaeocarpus floribundus* Blume
			Tulpai	*Elaeocarpus varunua* Buch.-Ham. *ex* Mast.
14	Euphorbiaceae	8	Alana	*Antidesma velutinum* Tul.
			Amloki	*Phyllanthus emblica* L.
			Atalia	*Chaetocarpus castanocarpus* (Roxb.) Thwaites
			Bura	*Macaranga denticulata* (Blume) Mull.Arg.
			Castoma	*Aporosa wallichii* Hook.f.
			Kechua	*Glochidion lanceolarium* (Roxb.)Voigt
			Painnatori	*Glochidion multiloculare* (Rottler *ex* Willd.) Voigt
			Pitali	*Mallotus nudiflorus* (L.) Kulju & Welzen
15	Fabaceae	1	Madar	*Erythrina fusca* Lour
16	Fagaceae	2	Batna	*Lithocarpus acuminatus* (Roxb.) Rehder
			Kali Batna	*Castanopsis tribuloides* (Sm.) A.DC.
17	Clusiaceae	2	Cow	*Garcinia cowa* Roxb. *ex* DC.
			Nagessor	*Mesua ferrea* L.

(continued)

Annex 4.1 (continued)

Sl. No.	Family	No. of Species	Local name	Scientific name
18	Lauraceae	5	Madarmosol	*Actinodaphne angustifolia* Nees
			Meda	*Persea bombycina* (King *ex* Hook.f.) Kosterm.
			Bhuiya gach	*Cryptocarya amygdalina* Nees
			Tejbohor	*Cinnamomum cecidodaphne* Meisn.
			Dulia	*Phoebe lanceolata* (Nees) Nees
19	Leguominosae	2	Lohakath	*Xylia xylocarpa* (Roxb.) Taub. Var. *Kerrii* (Craib & Hutch) I.C. Neilsen
			Tentul	*Tamarindus indica* L.
20	Lythraceae	1	Jarul	*Lagerstroemia speciosa* (L.) Pers.
21	Malvaceae	1	Bolana	*Hibiscus tiliaceus* L.
22	Meliaceae	3	Amoor	*Aglaia cucullata* (Roxb.) Pellegr.
			Chickrassia	*Chuckrasia tabularis* A. Juss.
			Mahagoni	*Swietenia mahagoni* (L.) Jacq.
23	Mimosaceae	8	Acacia Hybrid	*Acacia hybrid*
			Akashmoni	*Acacia auriculiformis* Benth.
			Chakua Koroi	*Albizia chinensis* (Osbeck) Merr.
			Kalo koroi	*Albizia lebbeck* (L.) Benth.
			Mangium	*Acacia mangium* Willd.
			Raj koroi	*Albizia richardiana* (Voigt) King & Prain
			Sada Koroi	*Albizia procera* (Roxb.) Benth.
			Tetua Koroi	*Albizia odoratissima* (L.f.) Benth.
24	Moraceae	5	Chapalish	*Artocarpus chama* Buch.-Ham. *ex* Wall.
			Dumur	*Ficus hispida* L.f.
			Jugga Dumur	*Ficus racemosa* L. var. racemosa
			Kanthal	*Artocarpus heterophyllus* Lam.
			Vortha	*Artocarpus lacucha* Buch.-Ham.
25	Myrtaceae	7	Phul Jam	*Syzygium formosum* (Wall.) Masam.
			Dhaki Jam	*Syzygium grande* (Wight.) Walp.
			Eucalyptus	*Eucalyptus camaldulensis* Dehnh.
			Golapjam	*Syzygium jambos* (L.) Alston
			Kalo jam	*Syzygium cumini* (L.) Skeels
			Peyara	*Psidium guajava* L.
			Puti jam	*Syzygium fruticosum* (Roxb.) DC.
26	Arecaceae	1	Khejur	*Phoenix sylvestris* (L.) Roxb.
27	Polygalaceae	1	Anonsak	*Xanthophyllum flavescens* Roxb.
28	Rhamnaceae	1	Boroi	*Ziziphus mauritiana* Lam
29	Burseraceae	2	Gurgutia	*Protium serratum* (Wall. *ex* Coelbr.) Engl.
			Vadi	*Garuga pinnata* Roxb.

(continued)

Annex 4.1 (continued)

Sl. No.	Family	No. of Species	Local name	Scientific name
30	Rubiaceae	4	Horula	*Tarenna campaniflora* (Hook.f.) N.P. Balakr.
			Kadam	*Neolamarckia cadamba* (Roxb.) Bosser
			Monkata	*Randia dumetorum* (Retz.) Lam.
			Rongkat	*Mitragyna parvifolia* (Roxb.) Korth. Var. *microphylla* (Kurz) Ridsdale
31	Rutaceae	1	Bel	*Aegle marmelos* (L.) Corr.
32	Sapindaceae	2	Lassal	*Schleichera oleosa* (Lour.) Merr.
			Litchi	*Litchi chinensis* Sonn.
33	Sterculiaceae	1	Udal	*Sterculia villosa* Roxb.
34	Theaceae	1	Kanok	*Schima wallichii* Choisy
35	Tiliaceae	1	Achargula	*Grewia nervosa* (Lour.) Panigrahi
36	Verbenaceae	5	Ashwal	*Vitex pubescens* Vahl.
			Bormala	*Callicarpa arborea* Roxb.
			Gamar	*Gmelina arborea* Roxb.
			Goda	*Vitex peduncularis* Wall. *ex* Schauer
			Teak	*Tectona grandis* L.f.
Total		93		

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Chapter 5
The Village Common Forest (VCF): Community-Driven Forest Conservation in Chittagong Hill Tracts

This chapter describes the historical background of village common forest (VCF) in the Chittagong Hill Tracts (CHT) and, then drawing on empirical data from Komolchari VCF, examines peoples' dependency, indigenous management, and forest health. Although public forests have been degraded seriously, the indigenous people in the CHT have been managing VCF sustainably for at least 200 years. It was found that not only members of the VCF, but also neighbors depend on VCF's resources for fuelwood, bamboo, timber, vegetables, wild fruits, vines, or medicinal plants. The VCF is a vital source of water supply and a storehouse of local biodiversity. The vegetation study identified 94 plant species with a mean density of 587 tree/ha and a mean aboveground biomass of 453 tree/ha. The VCF has been managed by informal indigenous rules. All villagers have equal access to resources and equally contribute to the protection and development of VCF. However, population pressure combined with improved marketing facilities, over exploitation, personal greed, and tenure insecurity is exerting pressure on VCF. Recognizing the traditional and customary resource rights of the indigenous communities, acknowledging resource management system, providing tenure security, encouraging communities through legal and financial incentives, and at the same time upholding the spirit of CHT Peace Accord 1997 could be important policy tools for the sustainability of VCF in the CHT.

5.1 Introduction

Since time immemorial forest has been used by the indigenous population for hunting ground, food gathering, swidden cultivation, grazing ground, charcoal making and minor forest produce collection including medicinal or herbal produces (Mahapatra 1997; Roy 2000, 2002; Halim and Roy 2006; Chowdhury 2008). While forests have always played an important role in human history, their rational management became a priority societal concern in the 1980s in both developed and

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developing countries (Biswas 1992). Recent studies show there is growing evidence that local community-based entities are good, and often better, managers of forests than federal, regional, and local governments (White and Martin 2002). Some study also contradicts with Hardin's (1968) well-known postulation, *the Tragedy of the Commons*, showing examples of successful common property regimes where users were able to restrict access to the resources and establish rules among themselves for its sustainable use (Feeny et al. 1990; Berkes et al. 1989; Rasul and Thapa 2005; Rasul and Karki 2006). Around the world, there are an increasing number of studies that highlight successes in community-driven forest management (Stocks et al. 2007; Ruiz-Pérez et al. 2005). The collective actions of local communities have resulted in regeneration of good forest stock leading to revival of the lost biodiversity (Panigrahi 2006). Communal management has remained as important option for a great number of communities and continues to be a potential strategy for the conservation and sustainable use of large parts of the world's forests (Arnold 1998). The Principle 22 of the Rio Declaration at Rio de Janeiro in 1992 on Environment and Development also emphasized the need to recognize the role of indigenous people and their traditional knowledge systems in environmental protection and sustainable development.

The indigenous communities in the Chittagong Hill Tracts (CHT) depend largely on forest commons to fulfill their basic subsistence requirements and cash income (Rasul and Karki 2006; Rasul 2007; Miah and Chowdhury 2004). The wide variety of plants and animals of the hill forests has supported the livelihoods of the hill people including dwelling, food, clothing, health care, festivals, and other activities. Village common forests (VCF), managed by indigenous communities, are essentially repositories of food, biodiversity, and medicinal plants, and their management have set a standard model for the protection of biodiversity, environment, and natural resources in CHT (Baten et al. 2010). VCF shows a rich biodiversity compared to government-managed reserve forests in CHT (Baten et al. 2010; Adnan and Dastidar 2011) although biodiversity is decreasing day by day (Baten et al. 2010). VCFs are good examples of effective community-driven forest management under certain customary rules and regulations (Baten et al. 2010; Halim and Roy 2006) but current trends of forest degradation do not show any sign of hope for indigenous communities and the environment. These VCFs are under severe threat (Roy and Halim 2002; Halim and Roy 2006; Tiwari 2003; Rahman 2005; Saha 2010) and in most instances common property regimes seem to have been legislated out of existence (McKean and Ostrom 1995). As a result, VCFs are degrading both in quantity (number and size) and in quality.

Many development projects have been implemented to combat forest loss and land degradation and also to improve the livelihoods of the hill people in CHT involving non-government organizations (NGOs) and other stakeholders (Nath and Inoue 2008a). But not all initiatives have been successful in attaining their target objectives due to several reasons of which most important are the lack of good governance (Nath and Inoue 2008b) and also rejection of the approach by the tribal people (Nishat and Biswas 2005; Rasul 2005). Most of these projects were concentrated in swidden commons and reserve forest areas to rehabilitate degraded

forests and forest people but no attempt has yet been taken by any government authority to address the issue of VCF in CHT. However, several national and international NGOs are working to improve the management of VCF in CHT including conservation of biodiversity and improvement of livelihood of the tribal communities (Halim and Roy 2006; Saha 2010; AF 2010; Nishat and Biswas 2005). Acknowledging the enormous social, economic, and ecological benefits of the VCF in CHT, this chapter of the book extensively reviews the political, administrative, and socioeconomic background of VCF establishment. Then drawing on an empirical case study, we studied peoples' dependency, indigenous management, and forest health of a VCF.

5.2 Historical Background of VCF

Village common forests are natural forests other than the government reserve forests around the households of the indigenous communities and are managed to fulfill their daily demands (Baten et al. 2010; Roy 2000). The VCF refers to any forested area collectively used and managed by village communities that is regarded as common property, irrespective of its legal classification (Roy and Halim 2002). According to the customary practice, each village identified an area within its territorial and jurisdictional authority reserved solely for use and extraction relating to domestic purposes (Roy 2000). Historically, indigenous people practice *jhum* (shifting cultivation) and traditionally keep a patch of forest adjacent to their village, known as a VCF, which is never used for *jhum* (Islam et al. 2009). They do so mainly for sustained flow of water in the streams but they also get timber, bamboo, and other minor forest products from such forests for household use (AF 2010).

The VCFs are commonly owned and managed by the community as a whole responsible for its upkeep and conservation which were later known as the *mauza reserves* or *service forests* (Tiwari 2003; Roy 2000; Saha 2010). These forests have also got different names in different tribal communities, such as *Jar* to the Chakma, *Kalittra* to the Tripura, *Bam* or *Thoikhuong* to the Marma, *Reserve* to Tanchangya, *Bam* to Khyiang, *Kua Bam* to Mru, *Kua Reserve* to the Bom, *Kua Service* to the Pankhua, *Service* to Lusai, *Jhumio Pui* to Khumi, and *Thingdhing Aka Ara* to the Chaks (Saha 2010). The VCFs are mostly small, averaging 20 to 120 hectares in size and consisting of naturally grown or regenerated vegetation (Islam et al. 2009; Halim et al. 2007; Saha 2010). There is controversy about the total number of VCF but it may be around 700–800 in CHT (Saha 2010). The VCF plays important role in conserving forest resources as well as fulfilling other demands of the forest-dependent communities. Some VCFs consist predominantly of bamboo brakes, some contain a more heterogeneous stand of flora and fauna, and many also contain herbaria for the village concerned, which the local healers use to prepare their traditional medicine, while others are regarded as sacred (Roy and Halim, 2002). Use and extraction of produce from VCF was need-based with each person taking only what was required, in order not to deplete the natural resources of this

forest which existed for the benefit of the entire community (Roy 2000; Saha 2010). This system still continues today in some villages and in most cases, VCFs are the only remaining natural forests in the surrounding area (Tiwari 2003; Roy 2000) and considered as the depository of traditional knowledge (Saha 2010).

Common property systems have historically governed the management of substantial parts of the world's forest resources that were often subject to some form of effective local control to prevent their overuse. The use of common land by the tribal people is not new in the CHT region because, since the British colonial period, the indigenous villagers who lost their access to the former common land eventually moved on to the state owned reserve forests. The result was an innovation based upon their traditional resource management patterns to retain forest cover for long-term use. This gave birth to the village common forests of today that are not allowed to be cultivated for *jhum* or otherwise on the strength of sanctions and religious taboos (Roy and Halim 2002), and which are directly managed, protected, and used by indigenous village communities (Halim and Roy 2006; Rahman 2005) during the first quarter of the twentieth century (Baten et al. 2010).

The acknowledgment of *mauza* reserves or VCF in the CHT Regulation 1900 and Indian Forest Act 1927 has also paved the way to start and manage village common forests by the communities. In response to these situations, indigenous communities have considered VCF as security of rights and daily necessities. However, it is the widespread deforestation at both state and individual levels that paved the way for the development of VCF in CHT. Tenure insecurity has acted as incentive to manage forest for long-term use and in some cases as disincentive to overuse of resources. Again remoteness of the villages from market places may also be considered as a factor for development of VCF or collaborative management to secure daily necessities from the forests.

Although the CHT Regulation and Indian Forest Act 1927 recognize the existence of VCF, neither the law concerned, nor the subsidiary or ancillary rules, regulations, or guidelines expressly provides for any system of titling or registration or other safeguards against privatization, alienation or permanent and detrimental change in resource use patterns (Halim and Roy 2006). This responsibility would appear to rest upon the *mauza* headman as no land grants are generally made without his advice in the CHT, although there are some notable exceptions (Halim et al. 2007).

5.3 The Komolchari VCF in Khagrachari: A Case Study

The case study was carried out in Komolchari VCF which is under Bhuachari *Mouza* (*Mouza* no—264) and village Komolchari under Khagrachari sadar upazila (Fig. 5.1). Total area of VCF is around 128 ha. The area is inhabited by Chakma community of village Komolchari. About 315 families live in this village.

The location of this forest is about 5 km from the village Komolchari. Two Tripura villages (*Thanachandrapara* and *Jadurampara*) are surrounded by the

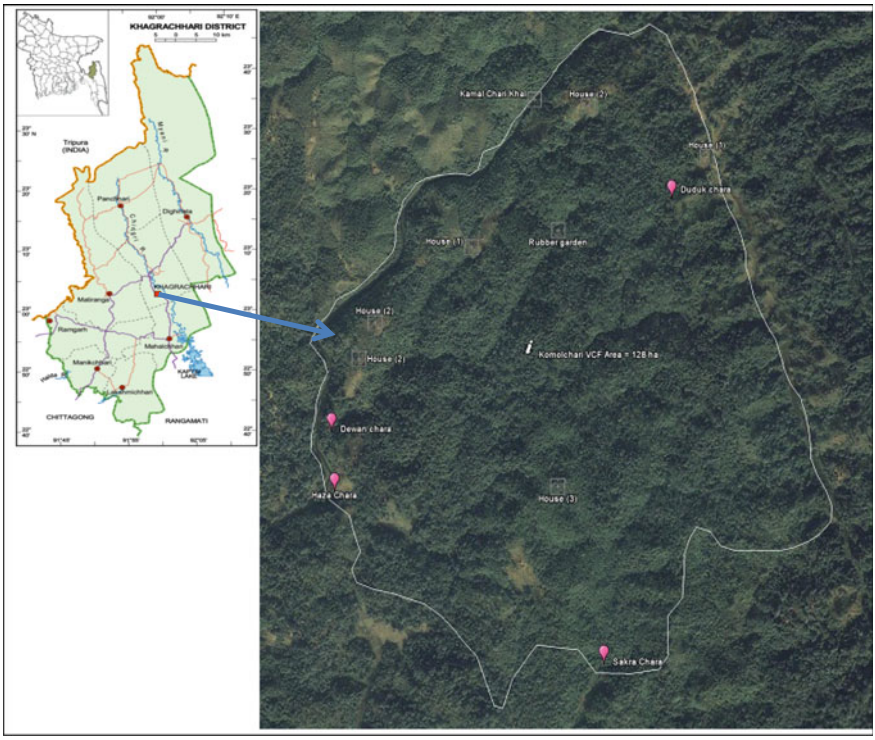

Fig. 5.1 Map of Komolchari VCF in Khagrachari, CHT

VCF. About 150 Tripura families live in each village. According to Chakma community, people of two Tripura villagers are the main agent of the destruction of the VCF. They collect bamboo shoot (*Bans karul*) for food and extract bamboo and timber for sale in the market. PROSHIKA, a leading national NGO, had been implementing a natural resource management project "Conservation and Restoration of Biodiversity of village common forest in Khagrachari" during the period of August 2011 to July 2014 with the financial support from Arannayk Foundation (AF). The objectives of this project were to protect the selected VCF and establish network with other VCFs, to improve livelihood of community people so that their dependence on forest resources could be reduced, and to strengthen the local institutions involved in VCF conservation. PROSHIKA was implementing its activities in Komolchari VCF too. We conducted this case study to explore the dependency of local communities on VCF, indigenous management, and forest health.

At the first instance, we categorized community people into two groups—owner (villagers of Komolchari) and neighbors (villagers of Thanachandra and Jadurampara). A total of 120 households, 60 from owner and 60 from neighbors, were randomly selected for household interview. Household interviews, carried out

by using a pretested semistructured questionnaire, were conducted to ascertain relevant data including occupation of household head, income and income sources, forest resource extraction from the VCF, and their opinion on VCF conservation. Two focus group discussions (FGD) were conducted in two sites with elderly people and 10–15 people attended in each. The discussions dealt with history of VCF management, local institutions, and future plan. A separate checklist was used to facilitate the discussion.

Floristic composition of the forest was assessed by walking through trails along streams, hill bottoms, mid-slope, and hill tops. All plants including climbers, grasses, herbs, shrubs, and trees along the trails were identified. Unidentified plant specimens were preserved as herbarium and finally identified by plant taxonomists.

During walk throughout the forest and talk to villagers and PROSHIKA staff members, we observed variation in forest coverage. Then we divided the whole forest into three categories: dense (30 % area), degraded (40 %), and open (30 %). For estimating quantitative forest structure and aboveground tree biomass, we laid out two concentric plots, each of 0.1 ha in size, in each forest-type category. In each 0.1 ha circular plot, we had subplots with 2, 5, and 17.84 m radiuses. In 2 m radius, we counted the number of seedlings; in 5-m-radius subplot, we measured diameter (≥1 cm to 5 cm) of all trees at breast height level. In 17.84-m-radius plot, we measured diameter (>5 cm) of all trees at breast height level. Plant form and status of occurrence was noted.

Vegetation data were analyzed for deriving forest stock (density, basal area, and biomass), diversity indices, and structural distribution of plants. Details of analysis are mentioned in Chap. 4.

5.4 Field Findings and Interpretation

5.4.1 Socioeconomic Status of the Respondents

It was found that more than 80 % respondents of both categories were practicing agriculture and it was their principal occupation (Table 5.1). Nearly 80 % respondents of owner category had their own agricultural land (mean 1.8 acre) compared to only 47 % in neighbor category (mean 1.0 acre). All respondents practiced agriculture on their own as well as on lease land. Although *jhum* was very common in earlier times, we found only 15 % neighbors were practicing it. They commented that privatization of land and declined productivity of *jhum* discouraged them from *jhumming*. Remarkable difference was seen in the case of wage labor; 81 % neighbors were working as wage labor while in owner village it was only 33 %.

Although agriculture was the principal occupation in both sites, villagers had little surplus to sell products into the markets which is evident from their income and sources (Table 5.2). Agriculture contributed 25 % and 27 % of total household income to the owner's and neighbor's groups, respectively. Homestead forests and

Table 5.1 Occupational status of respondents in the study areas

Variable	Owner	Neighbor
Agriculture	100	83
Jhum	–	15
Wage labor	33	81
Business	25	11
Service	26	11
Others	6	6

Note Others include livestock rearing, fishery, cottage industry, remittance, and rickshaw puller

Table 5.2 Mean annual income and income sources of the respondents

Variable	Owner	Neighbor
Homestead forest	19823 (34)	11179 (72)
Agricultural products	23441 (79)	18166 (58)
Jhum	–	5899 (15)
Fruit garden	22433 (24)	4584 (56)
Livestock	11328 (26)	11984 (19)
Wage Labor	26207 (33)	28706 (81)
Service	70678 (26)	66000 (11)
Business	71307 (25)	55125 (14)
Remittance	92000 (5)	–
Mean annual income	91,666 ± 20194	67,852 ± 10739
Mean annual expenditure	74,461 ± 12504	51,170 ± 5275

livestock jointly provided 34 % income in both sites. Wage labor contributed 29 % and 42 % household income in owner's and neighbor's groups, respectively. Even though few respondents had service and business, these two sectors offered lion portion of income. Considering all sources, mean annual income was found as Tk. 91,666 and Tk. 67,852 in both sites, respectively (Table 5.2).

5.4.2 Contribution of VCF to Household Economy

When we asked respondents about contribution of VCF to their livelihood 67 % owners and 53 % neighbors said that they derived livelihood support from VCF. As owners, they can harvest forest products, namely fuelwood, timber, pole, bamboo, and leaves, mainly for own uses following their committee rules (Plate 5.1). As per their rules, villagers collect fuelwood and bamboo every year. But they can collect timber and pole when needed for house construction. We were informed that some of them sell these products in the market for cash. Beside these products, they collect a variety of vegetables and medicinal plants for household consumption.

Plate 5.1 The Komolchari VCF and its resources used by the villagers. **a** A portion of village common forest (VCF). **b** A stream beside the Komolchari VCF. **c** Villagers prepared this pit beside VCF for drinking water. **d** Wild potato growing in the VCF. **e** Fuelwood collection from the VCF. **f** Catching small fishes from narrow stream inside the VCF

There are four streams (*chara*) originated from this VCF and meet together with Komolchari canal flowing beside the owner's village. The seepage water from the VCF keeps the canal alive and local people use water for bathing, irrigation, catching small fishes, and even transporting bamboo, logs from the forest (Plate 5.1). Neighbors had made a few wells in the VCF which they had been using for collecting drinking water.

Although neighbors had no ownership in the Komolchari VCF, they collected forest products. During the survey, respondents reported that 52 % owners and 46 % neighbors had collected, on an average, 327 and 530 maund (1 maund = 37 kg) of

Table 5.3 Extraction of forest products by the villagers

Product	Owner			Neighbor		
	Quantity/Year	For sale (%)	Market price (Tk)	Quantity/year	For sale (%)	Market price (Tk)
Fuelwood (Maund)	327 (52)	60 (2)	8331	530 (46)	50 (4)	19806
Timber (ft^3)	7.5 (3)	–	10750	49 (9)	70 (3)	12083
Pole (No.)	37 (21)	50 (2)	3182	49 (19)	–	2367
Bamboo (No.)	81 (79)	–	1874	407 (74)	60 (12)	8602
Leaves (bags)	–	–	–	10 (4)	–	2000
Total			24,137			44,858

Note Figures in parenthesis indicate percentage of respondents

fuelwood per year, respectively (Table 5.3). From the table, it is apparent that neighbors extracted more forest products than the owners themselves. It was due to the location of the VCF; owners were five kilometers away and neighbors were close to the VCF. Based on their estimate, the market price of extracted products for owners and neighbors would be Tk. 24,137 and 44,858 (1 US$ = Tk. 78), respectively.

5.4.3 Respondents' Opinion on VCF Conservation

Using an ordinal scale (1 = not good through 4 = very good), we analyzed trends of forest resources in the VCF. The figures indicate that situation of forest resources (fuelwood, timber, bamboo, and medicinal plants) in last five years was in-between good and very good (Table 5.4). Villagers reported that there were many big trees

Table 5.4 Trends of forest resources (1 = Not good, 2 = Fairly good, 3 = Good, 4 = Very good)

Product	Owner			Neighbor		
	In last five years	At present	In future	In last five years	At present	In future
Fuelwood	3.6	2.0	3.2	3.5	1.6	2.9
Timber	3.5	1.8	2.9	3.6	1.6	2.9
Bamboo	3.8	1.6	3.2	3.3	1.2	2.9
Medicinal plants	3.5	2.1	2.9	2.9	1.8	2.4
Mean	3.6	1.8	3.0	3.3	1.6	2.8

Note Figures are average value of four scales used

Table 5.5 Respondents' perception on VCF conservation

Variable	Owner	Neighbor
VCF conditions		
Deteriorating	49	55
Improving	48	27
No comment	3	18
Need to conserve VCF?		
Yes	95	80
No	–	2
No comment	5	18
Do you know the rules of VCF conservation?		
Yes	97	73
No	–	2
No comment	3	25
Do you have idea about penalty?		
Yes	97	73
No	–	–
No comment	3	27

and bamboos were growing vigorously. Due to illicit felling and bamboo flowering in 2008, the forest had been degraded. During the field visit, we saw very few big trees and new bamboo shoots were emerging. The deteriorating conditions of forests had also been reflected when we sought respondent's perception on VCF conservation (Table 5.5). More than 50 % respondents in both sites commented that VCF had been degrading. More than 80 % respondents said that they need to conserve the VCF as they depend on these resources for their livelihood.

Respondents were aware of the rules of VCF conservation. Ninety-seven (97) percent respondents of owner's village and 73 % of neighbor's village mentioned that they knew the rules and regulations for VCF management (Table 5.5). As forest conservation project was being implemented by the PROSHIKA, villagers expect that the forest would regain its original status in future. However, they warned that their dependency on forest resources needed to be reduced by introducing alternative income generation activities.

When asked, more than 60 % respondents in both sites commented that they needed alternative income generation opportunities so that they could support their livelihood, and hence, pressure on VCF would be reduced (Table 5.6). Most of the respondents had commented that they needed support for agriculture, livestock rearing, and for small rural business. Some of them also sought assistance for fishery and purchase of rickshaw and/or *tom tom* (three-wheeler motor vehicle). However, majority of them in both sites preferred to have support for livestock. During group discussion in neighbor's village, some respondents said that they could earn at least Tk. 20,000 in a year by rearing and selling a pig.

Table 5.6 Respondents' perception on alternative income generation

Variable	Owner	Neighbor
Do you need AIG		
Yes	66	61
No	34	39
AIG Purposes		
Agriculture	46	27
Livestock	41	35
Business	40	18
Fishery	8	2
Rickshaw/Tom tom	3	2

5.5 Forest Management and Forest Health

5.5.1 Forest Management: Indigenous Institution and Governance

The villagers of Komolchari had established the VCF 100 years ago. They reported that the VCF was very near to their village but due to expansion of village with increased population they had reestablished the present VCF 5–6 km away from their village about 55 years ago. Since then they had been managing the VCF following traditional communal land rights. Being away from the village, the villagers initially had formed 10 patrol groups (PG) each consisting of 10–15 members who protect the VCF from pilferage through regular patrolling. Although they had tried their best, it was really difficult to protect the VCF especially when illegal cuttings occurred during nighttime. In order to improve the situation, the villagers decided to settle some of their villagers around the VCF. In 2008, 11 families were relocated around the VCF and each of them was allocated two (02) acres of land for house construction and agriculture. The settlers patrol the VCF and can collect dry and fallen leaves, twigs, and stems.

There was an organization—*Palli Karma Sahayok* (PKS, Village Work Associate)—which took care of the VCF. Although it was established in 1973 and 1974, it was registered with local government council in 2001. The PKS had an executive committee consisting 19 executive members including two women members and villagers usually selected them through voice voting system. The committee lasts for three years and all members pay a monthly subscription of Tk. 5. The executive committee maintained liaison with NGOs and other concerned agencies, and formulate rules for VCF management. Some of their rules are mentioned in Box 5.1. In general, there are no written rules for VCF management. Each VCF committee has their own rules, but some rules are common for all the VCF that are strictly followed with the provision of penalties or sometimes exclusion from the clan in the case of rules violation. In VCF *jhuming* and hunting are strictly prohibited, all sorts of fireworks and unpermitted access are restricted, a penalty of Tk. 50 for each bamboo has to be paid if anybody cuts bamboo without

permission, immature bamboo extraction is restricted, harvesting of bamboo is generally done every 2 to 3 years, new plantation should be done by the members every year, the executive committee will approve the requirement of forest resources in general meeting before starting extraction, and commercial selling is forbidden unless the committee decides to spend the money out of the selling of forest products in community development.

Sometimes mature trees and bamboos are sold to create a fund to be used in disaster. Limited collection of resources at limited time period is also allowed as a custom and there is an option to harvest trees or bamboos from the VCF with the prior permission from the management committee for building or repairing houses, funeral of deceased, or any other need. If outsiders apply to the committee for extraction of some products with genuine ground, then the VCF committee allows them. Therefore, it seems that indigenous management of VCF in the CHT is concentrated on the regulation of access to and use of the resources, keeping the forests undisturbed and protecting the forests from illegal harvesting by the concerned community members including patrolling the forests, and as such the indigenous people have proved themselves to be efficient managers and custodians of forests in CHT (Halim and Roy 2006; Nayak 2002).

Villagers reported that 50–60 years ago there were many big native trees in the VCF. Streams remained full of water and they could catch variety of fishes. But due to intrusion of market economy that triggered illegal cutting of valuable trees, expansion of brick fields that use trees for fuel and above all increasing population imposed pressure on VCF. As a result, nowadays we can see only a few scattered big trees and bushy spaces in the VCF. Flowering of bamboo followed by rat flooding in 2008 resulted in the loss of bamboo groves. In order to boost bamboo regrowth, the villagers banned bamboo harvesting since 2008. We observed that new bamboo shoots were growing up vigorously.

In northern side of the VCF, villagers cleared 30–40 acres of forest land and planted with rubber seedlings. Army personnel were cutting some trees in that side and villagers thought that the Army might occupy the land. In order to protect the land from Army, villagers intentionally and quickly cleared the land. However, Army personnel did not continue. As villagers were not skilled enough to manage rubber plantations, most of the rubber trees had died. Villagers reported that due to clearing of land and planting with rubber trees nearby *Dudakchara* (one of four streams) had become dry. They commented that they would like to replant the rubber plantation area with native plant species.

Villagers mentioned that PROSHIKA, in 2011, had carried out enrichment plantation and planted nearly 1000 seedlings of 20 native tree species suggested by the PKS. Villagers commented that neighbors were the main threats for VCF conservation those collect bamboo shoots, fuelwood, and other minor forest products from the VCF.

Box 5.1 Traditional Rules of Komolchari VCF Management

Rules	Explanation
Rules for patrolling the VCF	Yes, 11 families were settled to patrol the VCF
Rules for collecting fuelwood for	If VCF committee permits; by paying Tk. 100 a family can collect fuelwood within one day
Rules for collecting timber	For building new house, emergency need based
Rules for collecting poles	If VCF committee permits
Rules for collecting bamboo	Before flowering of bamboo in 2008 every family used to get 200 free bamboo culms for personal use every year
Rules for collecting/selling forest products for community uses	VCF committee decides when needed
Punishment for violating these rules	Penalty will be double of market price, in the case of timber depending on size

If we look into the governance situation in the VCF, we can see that indigenous people had a long-term vision for the conservation of forest resources through the establishment of VCF. The VCF would meet the local energy demand, provide materials for house construction, and be a storehouse of livelihood means. According to their rules, all villagers who belong to their respective VCF have equal access to resources and equally contribute to the protection and development of VCF. If needed, they sometimes restrict forest product extraction for attaining regeneration. For example, the executive committee banned extraction of bamboo for the last 3–4 years because all bamboos had died due to flowering and they allowed regenerating bamboo naturally. The executive committee oversees the overall management of VCF but in the case of any punishment they ask village development committee to impose the sanctions. The executive committee collects revenue (if any) earned from VCF, but they deposit the money onto village development committee for use in social development purposes. It indicates that they maintain a hierarchy in governing not only the VCF management, but also in overall social development activities.

5.5.2 Forest Health of the Komolchari VCF

In forest trails survey, we counted 94 plant species (Annex 5.1) including grass, climbers, herbs, shrubs, saplings, and trees. Some common tree species include *Ficus racemosa, Ficus semicordata, Litsea monopetala, Microcos paniculata, Callicarpa arborea, Lannea coromandelica, Protium serratum, Streblus asper, and Syzygium cumini*. Villagers commented that most of the grasses, herbs, and shrubs have medicinal values to local people.

Forest survey through circular plots identified 92 plant species in the whole VCF. There was remarkable difference among three forest types regarding the

Table 5.7 Diversity indices, forest stock, biomass, and regeneration status of Komolchari VCF

Variable	Whole VCF	Forest type		
		Dense	Degraded	Open
No. of Species	92	87	33	18
Species Diversity Index (SDI)	121.05	85.84	36.96	20.06
Shannon-Wiener Diversity Index (H)	4.11	3.80	3.04	2.54
Species Richness (R)	42.80	33.76	16.33	9.68
Species Evenness (E)	0.50	0.03	0.73	0.88
Index of Dominance (ID)	0.03	0.04	0.07	0.11
Tree Stock (No./ha)	587 ± 351	955	525	285
Basal area (m^2/ha)	34.13 ± 13.94	49.30	16.39	8.06
Aboveground Biomass (tree/ha)	453 ± 10.43	687	222	105
Regeneration				
No. of Species	43	18	18	16
Density (No./ha)	65287 ± 34623	79618	91162	25,080
Bamboo (No./ha)	26,394	40207	59076	–

number of species where dense forest consisted of 87, degraded and open types consisted of 33 and 18 species, respectively (Table 5.7). Dominant species in the VCF were Castoma (*Aporosa wallichii Hook. F.,* IVI-18), Bura (*Macaranga denticulate* (Blume) Muell.-Arg., IVI-12), Gamar (*Gmelina arborea* Rorb., IVI-10), Ramjani (*Eurya acuminate* DC., IVI-8), and Nunia (*Macaranga indica* Wight, IVI-8). In dense forest type, Castoma was dominant (IVI-33) followed by Ramjani (IVI-13), Jam (*Syzygium* spp., IVI-12), and Ashar (*Streblus asper* Lour., IVI-8). In degraded type, the dominant species were Bura (IVI-40), Nunia (25), Bamboo (20), and Barmala (*Callicarpa macrophylla* Vahl, 14). On the other hand, in open type the dominant trees were Gamar (51), Dumur (*Ficus* spp., 30), and Sadakoroi (*Albizia procera* (Roxb.) Benth., 26).

Mean number of plants per hectare was 587 and as usual the highest density (955 stems/ha) was in the dense forest type. The average basal area per hectare was 31.94 m^2 and in dense forest types the value is 49.30 m^2/ha. Diversity indices also indicated that dense forest type was rich in species composition. For the whole VCF, mean aboveground biomass (AGB) was estimated 453 tree/ha. The AGB of dense forest type was more than six times than that of open forest type.

Regeneration study identified 43 species in the VCF and the density was 65,287 seedlings/ha of which bamboo represented 40 % of total seedlings. Regeneration in degraded forest consisted mostly of bamboo (65 %). However, no bamboo regeneration was seen in open forest.

We observed very few big trees in Komolchari VCF. It can be reconfirmed if we look at the distribution of plants in different diameter classes. Nearly 42 % plants in the whole VCF belonged to 5–10 cm dbh class and only 6 % plants had a dbh of

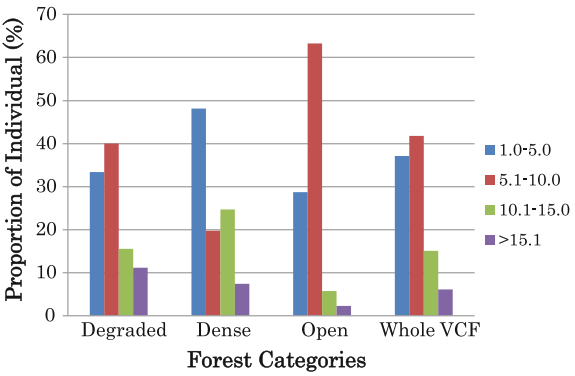

Fig. 5.2 Distribution of plants in different dbh (cm) classes in the Komolchari VCF

more than 15 cm (Fig. 5.2). In open forest land villagers (owners) planted Gamar which were growing well and 62 % of them attained dbh within 5–10 cm. We observed some topped trees (2 %) with little bigger dbh in open forest. In dense forest type, most of the plants (48 %) belonged to 1–5 cm dbh class which indicates that there was high regeneration in dense forests. In the case of degraded forest areas, 40 % plants were within 5–10 cm dbh class.

5.6 Discussion

We found that VCFs still are the sources of fuelwood, herbs, roots, bamboo shoots, wild fruits, vines, or leaves for cooking or medicinal use necessary to sustain the lives of the indigenous communities in the CHT. VCFs are also very rich in biodiversity harboring rare plant and animal species which are not usually found in the reserve forests (administered by the forest department) and the unclassed state forests (also known as swidden commons, administered by the Deputy Commissioner) due to continued deforestation and land degradation. The VCF can easily be identified with their thick canopy coverage consisting of naturally grown bigger trees, bamboos, and other plant species in or around the tribal villages. A recent study recorded a total of 163 plant species from 60 families (Jashimuddin and Inoue 2012). The indigenous communities are the important stakes of this rich biocultural system that have survived many centuries as model system of natural resource management and sociocultural harmony with nature. This was possible by their traditional institutions governing the natural resources as common property system based on social, cultural, and religious beliefs. In fact, the indigenous peoples of CHT have a rich tradition of maintaining and protecting their naturally grown or regenerated village forest commons that might be a cause for shame for many forest officials with their formal knowledge on forestry and biodiversity (Roy 2004) as there is growing recognition that governments and public forest

management agencies often have not been good stewards of public forests (White and Martin 2002).

Traditionally, the indigenous communities are smaller in size (generally less than 100 families in a *para* or village) having strong social, cultural, or religious kinship and are organized by the village elders or leaders, used to be selected democratically from the community, who hold a strong position upon the community members with their knowledge, experiences, leadership quality, and indigenous customs to guide and support their fellow members in their socioeconomic, cultural, and religious activities. Ciriacy-Wantrup and Bishop (1975) also mentioned that institutions based on the concept of common property have played socially beneficial roles in natural resources management from economic prehistory up to the present. So the role of institutions is very important for the sustenance of these VCFs in the CHT.

But unfortunately these traditional intuitions have been weakened by several government policies that aimed at increasing government revenue or extracting important natural resources combined with nationalization of forests, encouraging sedentary agriculture, privatization for long-term horticulture or tree plantation, government sponsored population migration program, or other development programs. Prior to the nationalization of forests, tribal people used to manage and use forest resources based on mutually agreed rules and regulations that had prevented forest encroachment by outsiders (Thapa and Rasul 2006). Experiences from CHT show that privatization and government regulation envisioned by Hardin (1968) to solve the tragedy of commons' problems have failed to reduce the problem of widespread deforestation and degradation of common lands, and to ensure effective management and conservation of those resources customarily owned and maintained by the tribal communities (Rasul and Thapa 2005). However, common property systems that have survived through considerable periods of change identify small size, internal homogeneity, functioning local leadership, and isolation from markets as important determinants of their endurance (Arnold 1998).

It is clear that VCFs are the only remaining forests in some parts of the CHT (Roy 2000) that are enriched with more biodiversity than that of government forests and indigenous management of resources was sustaining a balance between exploitation and conservation (Baten et al. 2010; Adnan and Dastidar 2011). So, there is an urgent need to protect and manage these VCFs from being degraded for the sake of indigenous people and the ecosystem as a whole. Indigenous communities face continuous threat of losing the VCF adjoining their homesteads because they do not have formal title (or common ownership) over them that again has been deepened by recent attempts of the forest department to acquire VCF for afforestation projects by claiming that these are mere "jungles" situated on state lands (Adnan and Dastidar 2011). Population pressure coupled with widespread resource destruction, livelihood insecurity, better market facilities, sociopolitical conditions, government policies, and consistent disregard from the part of government regarding protection and management is placing major threats to the sustenance of VCF in the CHT.

Another threat to the VCF arises from privatization by elite tribal people, including concerned *mauza* headmen and village *karbari* in some instances who are concerned to convert these common forests into homesteads, orchards, and other forms of private property, often with formal settlements and registered titles. This has been motivated from enhancing subsistence production to maximizing profit through market-based commercial production that has been heightened by the lack of awareness of land rights among their fellows as well as the erosion of traditional egalitarian and redistributive norms among the indigenous communities of the CHT (Adnan and Dastidar 2011). Sometimes it is also important to guard against internal inequities within the community based on gender, kinship, social status, or otherwise that disrupt social cohesion leading to the abandonment of community efforts to manage the forests (Halim and Roy 2006) which may arise due to local elites laying claim to a disproportionate share of resources (Sunderlin et al. 2008). Dependence of the community people on forests can also be considered as a factor of forest destruction particularly the VCF.

Realizing these facts, some NGOs, namely *DANIDA* and *Arannayk Foundation* in cooperation with local NGOs such as *Taungya, Biram, Humanitarian Foundation, Tah Zing Dong,* have initiated programs to protect and improve VCF and at the same time improving the livelihood of the community people to reduce their dependency on forests (Halim and Roy 2006; AF 2010) as there is no government initiative in safeguarding these common forests. Several authors have highlighted the role of NGOs in maintaining and safeguarding common forests in CHT and elsewhere (Nath and Inoue 2008a; Nath et al. 2010; Duthy and Bolo-Duthy 2003; Halim and Roy 2006). NGOs have added a new dimension in the forest management, which has ensured participation of the community people and protection of the vegetation (Zaman et al. 2011). However, it is important for the government to come forward with policies and some rules and regulations in giving the tenure security to the indigenous community who are maintaining the VCF for long and also encourage other communities to maintain VCF around or near their homesteads with some financial and legal incentives.

Legally, VCFs are under unclassed state forest (USF) land administered by the Deputy Commissioner (DC) of the respective hill district. But DC office has had no supervisory body to monitor the VCF or they do not interfere with communal VCF management. There are three Hill District Councils (HDC) in the CHT which had been empowered, in light of CHT Peace Accord 1997, to supervise forest management activities. We suggest that respective HDC could be efficiently empowered to collaborate with all VCFs in its jurisdiction for effective management. All VCFs should get registered with respective HDC. With due recommendation from the CHT Land Dispute Resolution Commission, the respective DC and HDC office jointly devolve property rights and management authority to the community people specifying the number of families and size of the VCF with a community-initiated management plan regulating management of forest resources, access to the forests, and equitable distribution of benefits among the community members. The HDC in collaboration with local FD office and VCF committee would approve and monitor the implementation of forest management plan.

As the indigenous people are very much dependent on the forests, the creation of alternative income generation (AIG) opportunities is also very important to reduce their dependency on forests, thereby conserving the forests and biodiversity. In consultation with local people, suitable AIG activities can be identified and may be implemented in collaboration with local NGOs. In the CHT, there are large tracts of degraded forest land that can brought under plantation programs by involving local people with acceptable benefit-sharing mechanism. Such kind of policy might work to increase forest coverage in the CHT at the same time benefit local people.

5.7 Conclusion and Policy Implications

VCFs in the CHT undoubtedly play an important role in biodiversity conservation as well as supporting daily necessities of the community people. However, population pressure combined with improved marketing facilities, ignorance, over exploitation, personal greed, tenure insecurity, faulty government policies regarding settlement of land and breakdown of the traditional systems exerting pressures on these VCFs, and the overall condition of these important biodiversity rich areas is degrading or shrinking in size and number gradually. In this situation, there is an urgency to initiate efforts to manage these sustainably both from government and from non-government (NGOs) initiatives.

In general, government forest authority has no control over these VCFs and they failed to show their efficiency to manage forests sustainably in CHT or other parts of the country. However, the government can come up with new policies and legal instruments especially recognizing the traditional and customary resource rights of the indigenous communities in the CHT, acknowledging resource management system, providing tenure security, strictly banning the transfer of VCF land to individual or for settlement purposes that will ease the protection of VCF and will earn the thrust of the tribal communities, encouraging communities through legal and financial incentives in protecting these VCFs or any other state owned forest areas solely for the conservation of biodiversity (only the indigenous species) with intensive management plan, resolving long-lasting land-related conflicts among indigenous communities, settlers and government authorities, and at the same time upholding the spirit of CHT Peace Accord 1997.

The NGOs showed their efficiency in maintaining biodiversity and safeguarding livelihood over the years, so they can be utilized to conserve VCF in CHT. It is still not too late to initiate a coordinated effort for these VCFs that will conserve the important biodiversity resources and provide essential life supports to the community people and help reduce environmental degradation which is now an important global concern from both social and economic points of view.

Annex 5.1 List of identified plant species found in the Komolchari village common forest

Local name	Scientific name	Family	Form	Occurrence
Achargola	*Microcos paniculata* L. Ex W. & A.	Tiliaceae	Shrub (SH)	Common (C)
Achunai, asampata	*Ageratum conyzoides* L.	Asteraceae	Weed (W)	VC (Very common)
Am	*Mangifera indica* L.	Anacardiaceae	T	Vulnerable (VU)
Amloki	*Phyllanthus emblica* L.	Euphorbiaceae	T	VU
Asamlata	*Mikania cordata (Burm.) Robinson*	Asteraceae	Herb (H)	VC
Bamboo	*Bambusa* spp.	Graminae	Grass	VC
Banana	*Musa sapientum* L.	Musaceae	H	VC
Barmala	*Callicarpa arborea* Roxb.	Verbenaceae	T	C
Betbegun	*Solanum nigrum* L.	Solanaceae	H	C
Bhadi	*Lannea coromandelica (Houtt.) Merr.*	Anacariaceae	T	C
Bhat	*Clerodendrum viscosum* Vent	Verbenaceae	Shrub (SH)	C
Bohera	*Terminalia bellerica* (Gaertn.) Roxb.	*Combretaceae*	T	VU
Borta	*Artocarpus lacucha Buch.-Ham.*	Moraceae	T	VU
Buddunarikel	*Pterygota alata* (Roxb.) R. Br.	Sterculiaceae	T	Endangered (EN)
Bura	*Macaranga denticulate* (Blume) Muell.-Arg.	Euphorbiaceae	T	VC
Castoma	*Aporosa wallichii* Hook. F.	Euphorbiaceae	T	VC
Chakua koroi	*Albizia chinensis* (Osbeck) Merr.	Leguminosae	T	C
Chapalish	*Artocarpus chaplasha* Buch-Ham.	Moraceae	T	VU
Chatian	*Alostonia scholaris* R. Br.	Apocynaceae	T	VU
Chepiche	*Porophyllum tagetoides* (Kunth) DC.	Asteraceae	Cl	C
Chensi	*Alternanthera sessilis* (L.) R. Br.	*Amaranthaceae*	H	C
Dakroom	*Mitragyna parviflora* (Roxb.) Korth.	Rubiaceae	T	VU
Dharmara	*Stereospermum personatum* (Hassk.) Chatterjee	Bignoniaceae	T	EN
Fuljhumuri	*Anogeissus acuminata* (Roxb.) Wall. *ex* Bedd.	Combretaceae	T	EN
Gamar	*Gmelina arborea* (Roxb.) DC.	Verbenaceae	T	Planted

(continued)

Annex 5.1 (continued)

Local name	Scientific name	Family	Form	Occurrence
Gandabadhuli	*Paederia foetida* L.	*Rubiaceae*	Cl	C
Goda	*Vitex glabrata* R. Br.	Verbenaceae	T	VU
Gutgoita	*Protium serratum* (Wall. *ex* Colebr.) Engl. (*Bursera serrata* Wall. *ex* Colebr.)	Burseraceae	T	C
Haritaki	*Terminalia chebula* Retz.	Combretaceae	T	VU
Harba	*Streblus asper* Lour.	Moraceae	T	C
Honagola	*Oroxylum indicum* (L.) Vent.	Bignoniaceae	T	VU
Jam	*Syzygium cumini* L. Skeels.	Myrtaceae	T	C
Jambura	*Citrus grandis* (L.) Osbeck.	Rutaceae	T	Planted
Joiggadumor	*Ficus semicordata* Buch-Ham. *ex*Smith.	Moraceae	T	C
Jagannagola	*Ficus racemosa* L.	Moraceae	T	C
Jalpai	*Elaeocarpus robustus* Roxb.	Elaeocarpaceae	T	VU
Jarul	*Lagerstroemia speciosa* L. Pers.	Lythraceae	T	VU
Kadam	*Anthocephalus chinensis* (Lam.) Rich	Rubiaceae	T	VU
Kajubadam	*Anacardium occidentale* L.	*Anacardiaceae*	T	Planted
Kala koroi	*Albizia lebbeck* L. Benth.	*Fabaceae*	T	VU
Kao	*Garcinia cowa* Roxb.	*Clusiaceae*	T	VU
Kanta marish	*Amaranthus spinosus* L.	*Amaranthaceae*	H	VC
Kathal	*Artocarpus heterophyllus* Lamk.	Moraceae	T	Planted
Konak	*Schima wallichii* Choisy	Theaceae	T	EN
Lajjabati	*Mimosa pudica* L.	*Mimosaceae*	Cl	VC
Lichu	*Litchi chinensis* Sonn.	Sapindaceae	T	Planted
Lohakhat/Pyinkado	*Xylia xylocarpa* Roxb. Taub.		T	VU
Molaccana koroi	*Paraserianthes falcataria* Linn. Roxb.	Leguminosae	T	VU
Meda	*Litsea monopetala* (Roxb.) Pers.	Lauraceae	T	C
Monermoto gach	*Litsea glutinosa* (Lour.) Roxb.	Lauraceae	T	C
Maru	*Phyla nodiflora* (L.) Greene	Verbenaceae	H	C
Mrunachi	*Hyptis brevipes* Poit.	Lamiaceae	H	C
Nengara	*Hyptis suaveolens* (L.) Poit.	Lamiaceae	H	VC
Nunia	*Macaranga indica* Wight	Euphorbiaceae	T	VC
Payera	*Psidium guajava* L.	Myrtaceae	T	C

(continued)

Annex 5.1 (continued)

Local name	Scientific name	Family	Form	Occurrence
Pitali	*Trewia polycarpa* Benth	Euphorbiaceae	T	VU
Ramjani	*Eurya acuminate* DC.	Theaceae	T	VC
Rubber	*Hevea brasiliensis* Mull. Arg.	Euphorbiaceae	T	Planted
Sada koroi	*Albizia procera* (Roxb.) Benth.	Leguminosae	T	Fairly common
Segun	*Tectona grandis* L.F.	Verbenaceae	T	Planted
Simul tula	*Bombax ceiba* L.	Bombacaceae	T	VU
Sungrass	*Impereta cylindrical* (L.) P. Beauv.	Poaceae	Grass	VC
Tetul	*Tamarindus indicus* L.	Leguminosae	T	VU
Toon	*Toona ciliata* M. Roemer.	Meliaceae	T	Fairly common
Udal	*Sterculia villosa* Roxb.	Sterculiaceae	T	VU
Ulotkombal	*Abroma augusta* L.	Malvaceae	SH	C

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Chapter 6
Community Participation in Agroforestry Development: Lessons Learned from a Collaborative Research Project

Community participation is now considered as an important element of any development programs. For development, adoption, and promotion of any agricultural technology, effective community participation is essential. In this chapter, we discuss the process and level of community participation in agroforestry development, state of agroforestry, and participant's opinion on sustainability of agroforestry. We also discuss the challenges and opportunities of agroforestry development. By using several tools of participatory rural appraisal, relevant field data were collected from a collaborative agroforestry research project being implemented in Chittagong Hill Tracts (CHT), Bangladesh, by scholars of University of Chittagong.

In order to ensure spontaneous local participation, project authority has first attempted to create trust in participants through continuous interactions, repeated explanation of project support and benefits, and holding several meetings in the presence of all villagers, local NGO and agricultural officers, school teachers, and village leaders. Villagers selected 31 project participants from three villages considering their willingness to join, allocating one acre of shifting cultivation land, and cooperating with project authority. Considering participant's preference and experts' opinion, crop combination was selected and an agri-horti-silvicultural type of agroforestry system was developed. Even though participants used to grow agricultural crops along hill slope every alternate year, now they cultivate every year across the hill slope. A benefit–cost ratio for agricultural crops was estimated at 3:1. Planted seedlings are growing well, and average survival rate is more than 70 %. More than 80 % participants are interested to continue agroforestry even after project funding ends, and 54 % of them desire to expand agroforestry in other areas. Even though they have been rigorously motivated, some participants did not work according to project authority's recommendations. For future development and promotion of agroforestry by involving ethnic communities in CHT, it is suggested to work closely in small areas in collaboration with local partners.

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6.1 Background

Much of the land in Southeast Asian countries is dominated by mountainous topography and populated by diverse cultural minority communities. Expansive forests and sparse populations allowed these communities to practice variations of shifting cultivation, which enabled them to coexist in relative harmony with their environment (Cairns and Garrity 1999). This cultivation system occupies a distinct place in the indigenous economy and constitutes a vital part of the livelihood and socioeconomic setup of the majority of the highland population. It was the first cropping system used by early agricultural occupants of many forested areas all over the world and is still dominating and codominating with more permanent agricultural systems in tropical regions of developing countries (van Vliet et al. 2012, 2013; Fox et al. 2014; Li et al. 2014). Despite rapid economic development in many tropical countries, millions of people, particularly in the humid tropics, still practice some form of shifting cultivation (Mertz et al. 2008; van Vliet et al. 2012). For centuries, shifting cultivation was the primary mode of use of tropical forests among the indigenous peoples inhabiting the humid tropics (Toledo et al. 2003). The production system is endowed with subsistence needs and market economy, but rapid changes of population density, land-use changes, and government policy on restricting shifting cultivation raise the question of its sustainability (Rahman et al. 2012a; Dressler et al. 2015).

Shifting cultivation could be said to have evolved as a response to special physiographic characters of the land, and the economy and sociocultural traditions of the cultivators practicing it (Gupta 2000). In Belize, the *milpa* type of slash-and-burn agricultural system evolved in response to local conditions, which is characterized by mountainous topography dominated by Mayan ethnic people (Emch 2003). Two major ecological reasons are considered for the use of shifting cultivation—poor fertility of fragile soils under tropical conditions, with a tendency to decline further without modern soil conservation and irrigation measures, and the low capacity of soil to retain plant nutrients (Gupta 2000). Traditional shifting cultivation remains sustainable as long as there is a balance, within a given area, between demand for land driven by population growth, the availability of land, and appropriately long fallow periods (Palm et al. 1996; Abizaid and Coomes 2004; Jakobsen et al. 2007).

Shifting cultivation, once a subsistence farming system of mountainous people, has become unsustainable both environmentally and economically, and many Asian countries are replacing the system with permanent commercial agriculture and monoculture cash crops (Rasul and Thapa 2003; Castella et al. 2013; Patel et al. 2013; Vongvisouk et al. 2014). Traditional pattern of shifting cultivation has gradually or abruptly been modified due to the integration of the indigenous communities into the regional, national, and global markets, and they have adopted new cultivars, domestic animals, and technologies (Toledo et al. 2003; Fox et al. 2014; Dressler et al. 2015). Recent studies indicate that farmers involved with shifting cultivation experience food shortage and adopted some other non-farm

activities such as wage labor, extraction, and selling of forest products to sustain their living (Nath et al. 2005a; Chakma and Kazuo 2008; Swapan et al. 2010; Rahman et al. 2012a).

Despite the trend of dwindling productivity, tribal people of the CHTs still practice shifting cultivation (*jhum*) as a dominant hill farming system to support their livelihood. But a rapid rise in population, the construction of development infrastructure (e.g., hydroelectric projects), and government policies on expansion of reserve and protected forests have made the *jhum* vulnerable. Due to repeated shortening of the fallow period, *jhum* productivity has been reduced markedly, and soil can no longer regain its natural fertility in a short time. An input–output analysis shows that the present low productivity of *jhum* jeopardizes the livelihood of *jhumias* (Nath et al. 2005a).

In the uplands (particularly in CHTs) of Bangladesh, a rapid rise in population, endemic and in-migration of plains people, the construction of development infrastructures (e.g., hydroelectric project), and government policies on expansion of reserve and protected forests have made the *jhum* vulnerable. An alternative farming system is required in the region in order to create sustainable land-use systems, improve farmer's living standards, reduce deforestation, and protect the watershed. Several farming systems have been promoted around the world to replace the shifting cultivation. Among the farming systems introduced, agroforestry has been extensively promoted (Nath et al. 2005a). However, confronted with necessary supports such as institutional, policy, and land tenure insecurity, shifting cultivation is still being widely practiced in mountainous areas of many countries (Khisa 2002; Millat-e-Mustafa et al. 2002; Roy 2002; Nath et al. 2005b, Rasul et al. 2004).

This chapter drawing empirical data from a community-based agroforestry development project explores the opportunity and challenges of community involvement in agroforestry development. More specifically, it examines the following:

- The process of agroforestry development,
- The level of community participation in agroforestry development project,
- Current status of agroforestry, and
- Community perception on sustainability of agroforestry.

6.2 Promotion of Agroforestry for Reducing Shifting Cultivation

Agroforestry is a farming system that integrates crops and/or livestock with trees and shrubs, and is gaining recognition as a viable alternative to shifting cultivation (Garrity 1999a; Levasseur and Olivier 2000; Fischer and Vasseur 2002; Kusters et al. 2008; Garrett 2009; USDA 2011; Gold and Jose 2012). Agroforestry can be

seen as a form of sustainable intensification of agroecosystems. Sustainable intensification is defined as a process or system where yields are increased without adverse environmental impact and without the cultivation of more land (Royal Society 2009; Pretty et al. 2011; Pretty and Bharucha 2014). The concept is thus relatively open, in that it does not articulate or privilege any particular vision of agricultural production (Garnett and Godfray 2013; Smith 2013). It emphasizes ends rather than means and does not predetermine technologies, species mix, or particular design components. Sustainable intensification can be distinguished from former conceptions of "agricultural intensification" as a result of its explicit emphasis on a wider set of drivers, priorities, and goals than solely productivity enhancement. The combination of the terms was an attempt to indicate that desirable ends (more food, better environment) could be achieved by a variety of means (Royal Society 2009; FAO 2011; Foresight 2011).

It has been reported that among several cropping systems (e.g., monoculture of fuelwood, timber, rubber, coffee, and fruits), agroforestry was found to be the best option to replace or supplement shifting cultivation (Bhatt et al. 2001). Agroforestry models can be implemented for long-term sustainability, profitability, and minimization of resource and environmental risks particularly in the region where shifting cultivation has already caused serious environmental degradation (Bhatt et al. 2010). Agroforestry plays a major role in supporting the socioeconomic needs, providing and animal feeds (Gockowski et al. 2010; Millard 2011; Rahman et al. 2012b). High-value trees including fruit-tree-based agroforestry are popular in highland areas and play a complementary role with other activities in the subsistence farming system, contributing in increasing the total productivity and food security in the communities (Bucagu et al. 2013).

As a land-use system, agroforestry has been increasingly regarded as an effective and low-cost method for minimizing the processes of degradation associated with land cultivation and for the retention of the ecosystems (Vergara and Nicomedes 1987). Moreover, diversification of crops is expected to create opportunities for achieving a steady and sometimes higher rural income through more efficient use of resources and the exploitation of comparative advantages. Farmer-evolved agroforestry often resembles natural secondary forest systems in structure and ecology (Garrity 1999b). Agroforestry system can combine short-term and long-term benefits for the farm households with the aim of watershed protection and sustainability in the use of resources.

The emphasis of agroforestry in developing countries is on alleviating poverty, securing nutritional security, and arresting land degradation, particularly under resource-limited conditions and lower input situations, which cover an estimated 1.9 billion hectares of land and 800 million people (Nair 2007). In this context, agroforestry has been considered as one of the best options to replace/supplement shifting cultivation (Bhatt et al. 2001). It has increasingly been seen as one of the major strategies for sustainable forest management approach that brings social, ecological, and economic benefits to farmers (Schroth et al. 2004; Williams-Guillén et al. 2008; Jose 2009; Mosquera-Losada et al. 2009; Nair et al. 2009; Rahman et al. 2012b; Millard 2011). Research and development projects have demonstrated that

agroforestry increases household incomes and generates environmental benefits (Franzel et al. 2001, 2004). The incorporation of trees or shrubs in agroforestry systems can increase the amount of carbon sequestered compared to a monoculture field of crop plants or pasture (Kirby and Potvin 2007; Jose 2009). In addition to the significant amount of carbon stored in aboveground biomass, agroforestry systems can also store carbon belowground (Jose 2009).

Agroforestry enhanced nutrient uptake by tree and crop roots from varying soil depths, and can improve soil fertility, increase crop yield, and be considered as a sustainable agricultural production and land management system in the tropics (Young 1997; Nair et al. 1999; Nair and Graetz 2004). Agroforestry models can be implemented for long-term sustainability, profitability, and minimization of resource and environmental risks particularly in the region where shifting cultivation has already caused serious environmental degradation (Bhatt et al. 2010). Agroforestry plays a major role in supporting the socioeconomic needs and improving the livelihood conditions of the people, and it is a viable livelihood option to raise income and reduce poverty as well as improving sustainable livelihoods (Rahman et al. 2012a). Agroforestry systems retain a diverse canopy of trees that provide shade, shelter, fuel sources, additional subsistence and cash crops, animal fodder, and a range of environmental services that contribute to the farm's economy (Gockowski et al. 2010; Millard 2011).

High-value trees including fruit-tree-based agroforestry are popular in highland areas and play a complementary role with other activities in the subsistence farming system, contributing in increasing the total productivity and food security in the communities (Bucagu et al. 2013). Some agroforestry technologies provide wood for timber, poles for construction, and fuelwood; hence, they are an integral part of the household subsistence needs (Thangata and Alavalapati 2003). By selecting suitable trees and appropriate tree management, high-quality timber can be produced without influencing agricultural crops excessively (Nerlich et al. 2012). At the same time, it can make a significant contribution to conserving biodiversity in a wide range of settings such as in complex agroforests and swidden succession. (McNeely 2004). In the regions, particularly in upland areas where population increases rapidly and in a steady way, and where land become exhausted due to increasing population pressure, deforestation, and intensification of traditional cultivation, agroforestry is considered as a candidate for alternative land uses that might bring social, economic, and ecological improvement of the upland societies.

6.3 Community Participation and Agroforestry Development

Since the 1970s, participatory methods have become popular throughout the social sciences, including the burgeoning fields of sustainable development and natural resource management (Bell et al. 2012). Participation has emerged as an appropriate

approach for enhancing natural resources management (Luyet et al. 2012). There is a growing realization that stakeholder participation has a significant role to play in the development and delivery of biodiversity policy and practice (Jones-Walters and Cil 2011). In order to solve complex problems of natural resource management, community participation is inevitable.

Community participation is a process by which people are enabled to become actively and genuinely involved in defining the issues of concern to them, in making decisions about factors that affect their lives, in formulating and implementing policies, in planning, developing, and delivering services, and in taking action to achieve change (WHO 2002). It is the process through which stakeholders' influence and share control over priority setting, policy making, resource allocations, and access to public goods and services (Anon 2012). The process of community participation respects the rights and responsibility of community members to diagnose causes of a community problem and to actively engage in designing, implementing, and evaluating programs that are intended to improve the problem (Hauser 2002).

Community participation enables projects to focus on the identified needs of the people they serve, promoting sustainable development now and in the future by creating reciprocal partnerships, building capacity, and empowering individuals (RWI 2012). Promoting participation helps build ownership and enhances transparency and accountability, and in doing so enhances effectiveness of development projects and policies (Anon 2012). Public participation is becoming increasingly embedded in national and international environmental policy, as decision makers recognize the need to understand who is affected by the decisions and actions they take, and who has the power to influence their outcome (Reed et al. 2009). Stakeholder's participation and involvement encourages "ownership" of the plan, can engender trust among all partners, and can reduce conflict (Pomeroy and Douvere 2008). Participation in the form of community-based management of common pool natural resources has been promoted to improve their management and empower local communities (Sultana and Abeyasekerab 2008). Rural development practitioners suggest involving local participants in the policy-making process for successful implementation of development programs (Prager and Freese 2009).

Development and diffusion of appropriate farming technologies for upland development is a great challenge, because uplands are characterized as fragile environment, farmers are poor with little capital for investment, remote location of village from markets, and very poor communication networks. The process of developing and disseminating agroforestry as a viable alternative for farmers under various ecological and socioeconomic conditions has become challenging constraint to promote agroforestry (Neupane et al. 2002). Participatory research methods hold the greatest potential for integrating farmers into the process of designing agroforestry systems (Haggar et al. 2001). Although the process of developing and disseminating agroforestry as a viable option for farmers under various ecological and socioeconomic conditions has been challenging (Jerneck and Olsson 2013; Matata et al. 2013), recent use of participatory methods has shown the

potential for integrating farmers into the design and management of agroforestry systems (Haggar et al. 2001; Bell et al. 2012; Luyet et al. 2012). Diffusion of information through farmers' interaction with extension agencies can positively influence the adoption and dissemination of new technologies (Smit and Smithers 1992; Besley and Case 1993).

Community-based organizations are increasingly considered a sustainable way to scale up the benefits of agricultural research and development from a few farmers in isolated pilot project areas to spread more widely across geographical and socioeconomic gradients (Noordin et al. 2001; Sultana and Thompson 2008; Sultana and Abeyasekerab 2008; Pretty et al. 2011). The benefits of community-based approaches to scale up agroforestry are that partnerships between farmers, government agencies, and other service providers are strengthened; information flow and awareness of the options spread among farmers; and farmers' participation, empowerment, and innovation are enhanced (Noordin et al. 2001; Blay et al. 2008; RWI 2012).

6.4 The Study Project

The name of studied project is "Coordinated Project on Improvement of Agroforestry Practices for Better Livelihood and Environment: CU Component" (hereafter AF project). It is a research project funded jointly by Government of Bangladesh and World Bank. Bangladesh Agricultural Research Council (BARC) is the coordinating agency, and two scholars of Institute of Forestry and Environmental Sciences, University of Chittagong (IFESCU), are involved as project investigators. It is a two-year project (2011–2013) and is being implemented in Wagga union of Kaptai Upazila (subdistrict) in Rangamati Hill District (Fig. 6.1). Rangamati Hill District is one of the major hilly regions of Chittagong Hill Tracts (CHTs) in Bangladesh with an area of about 6116 sq. km and geographically located between 22°37′60N and 92°12′0E.

The project site is a hilly area with some limited extent of agricultural land in-between hills. Major economic activities in the project site are based on agriculture. Participants have been practicing irrigated agriculture, jhum, plantation (mostly monoculture), fruit garden, and homestead agroforestry.

There are 30 paras (villages) in Wagga union having a total population of 10600 in 1835 families. Three villages (namely Pagli nichu para, Pagli middle para, and Pagli upor para) were then selected purposively based on availability of land for agroforestry plots, accessibility, willingness of community people to participate in the project, and having government and NGO's activities in the areas. Some of the basic information about the project site is given below (Table 6.1). Pagli upor para is situated on the top of the hill, 2.5 km away from Kaptai–Rangamati road, and there is no agricultural land in this para. Pagli middle para lies on the top and valley of the hill, 2.0 km from Kaptai–Rangamati road, and have limited agricultural land

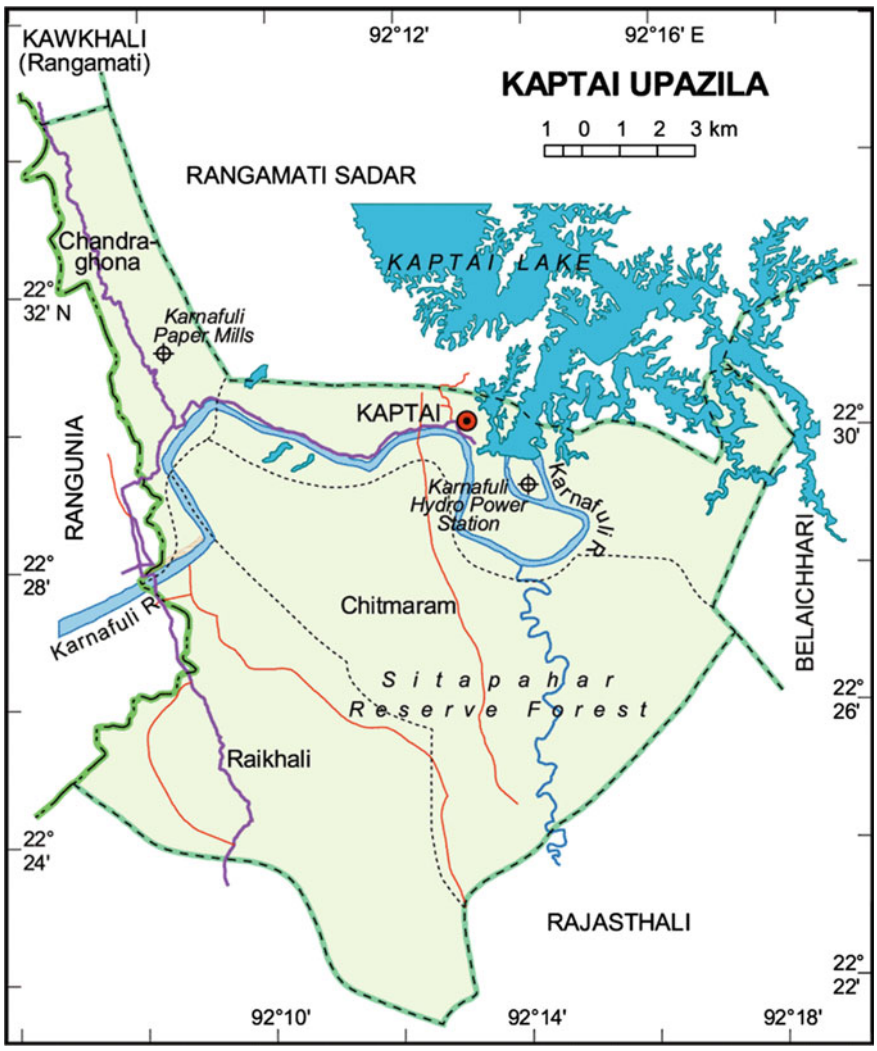

Fig. 6.1 Map of Kaptai Upazila showing the study area with red circle

where villagers grow agricultural products including sugarcane, vegetable, and paddy. Pagli nichu para is situated on the mid-slope of the hill, 1.5 km from Kaptai–Rangamati road.

Considering project budget 30 participants, 10 from each para were selected as project beneficiaries. Each participant allocated one acre of jhum land for the development of agroforestry plots. AF project authority supplied planting materials, fertilizer, and provided technical support and financial support for labor (partial). A total of 10 plots, about one acre each, in each village, were selected. Thus, a total

Table 6.1 General information about the project sites

General information	Name of village/para		
	Pagli nichu para	Pagli middle para	Pagli upor para
Number of households	26	27	35
Population	250	220	260
Ethnicity	Tanchungya		
Distance to Rangamati town	30 km		
Distance to main road	1.5 km	2 km	2.5 km
Distance to main market	5 km	5.5 km	6 km

of 30 plots were selected from the project site. In addition to this, one plot was also selected from the CU campus for this purpose to see whether there is any difference in outcome.

6.5 Research Approach

Before conducting field data collection, we reviewed project documents such as proposal, reports to have idea about project objectives and activities. After review of these documents, we hold a meeting with project investigators to reconfirm project purpose and implementation of activities. We asked them about project initiation, field implementation, opportunity and challenges of working with tribal people, and sustainability of project activities when funding ends.

Then, we conducted field study by employing several tools—personal observation, semi-structured household interview, and group discussion—of participatory rural appraisal (PRA) research method. We observed prevailing farming practices in project sites, identified composition and assessed growth of seedlings of 30 agroforestry plots in three para.

Household interviews of 30 participants were conducted using a semi-structured questionnaire. The questions included were related to household information such as sociodemography, landholding, occupation, and income, AF project related such as supports they received, opinion on importance of AF project, agroforestry and its sustainability, and level of participation in project activities. We collected data on yield of agroforestry crops and cost involved and then estimated a benefit–cost ratio.

Several group discussions were hold in three para, and 6–8 participants attended at each meeting. The discussion highlighted issues such as past farming practices, their merits and demerits, history of their involvement in AF project, opinion on benefits/problems of AF project, and sustainability of agroforestry after AF project ends. In a separate group of 10–15 participants from three para, a participatory scoring was conducted using three scales (3 = the highest, 2 = medium, and 1 = the lowest) to explore participant's preference on choice of fruit species. The study was carried with several intermittent field visits between 2011 and 2013. We analyzed findings of this study both qualitatively and quantitatively.

6.6 Field Findings and Interpretation

First, we describe basic socioeconomic profile of participants followed by an analysis of farming practices in the study site before AF project. Then, we analyze approach and implementation of AF project activities, performance of agroforestry, and participant's opinion on project benefits and sustainability of agroforestry. Finally, we discuss impact of project intervention on farm productivity and lessons learned in terms of opportunity and challenges.

6.6.1 Socioeconomic Profile of the Participants

Data on basic socioeconomy of participants are shown in Table 6.2. The average age of the participants is 37, indicating that they are quite adult to understand the project activities and able to help in implementing field activities.

Education level was calculated in terms of their total years of education, and as such, average schooling was found seven (7) years across three paras. Agriculture is found to be the primary occupation of all participants (100 %) in three paras, and hence, all of them are primarily farmer. Other notable occupations are small village business (e.g., tea stall, grocery shop) and service mainly in garments industries. The mean number of household members is five (05) having an average of two economically active members in each household. Age gradation of household members also indicates that 81 % members belong to 11–59 years of age gradation that is usually considered as active family members. Being located near to main road, participants of Pagli nichu para have better access to schools, and hence, level of education is higher (62 %) than that of Pagli middle and upor para.

Livestock rearing is an important income generation activity of the participant's families. They usually do it for cash income as well as for own consumption. On average, 50 % households have poultry (mean number 6) and 30 % of them have cow (mean number 1). Landholding status reveals that the participants allocate most of their land (37 %, 545 decimals, 1 ha = 247 decimals) for jhum followed by agriculture (17 %), plantations (14 %), and fruit gardens (14 %). The average landholding across three paras is 1481 decimals.

Status and sources of income indicate that mean annual income of participants in 2011 is BDT 213,516 of which 38 % obtained from the sale of jhum products followed by fruits garden (16 %), plantation (13 %), and homestead forest (13 %). Homestead forests and jhum are considered as traditional agroforestry, and hence, we can say that more than 50 % family income is obtained from agroforestry. Participants reported that although they obtained income from plantations and agriculture in last year (2011), they do not obtain similar income from these sources every year.

Table 6.2 Basic socioeconomic information of the participants

Variable	Pagli nichu para	Pagli middle para	Pagli upor para	All three paras
Average age of participants (years)	38	43	30	37
Education level of respondents (years of education)	9	5	7	7
Occupation (%)				
Farming	100	100	100	100
Business	10	40	40	30
Service	10	–	10	7
Mean household members (No.)	5 ± 0.5	6 ± 0.7	4 ± 0.6	5
Male–female ratio	1:0.95	1:1.08	1:1.08	1:1.03
Economically active members (No.)	2	3	2	2
Member's age classes				
<11 years	21	7	25	18
11–59 years	76	93	75	81
>59 years	3	–	–	1
Member's education status (%)				
Illiterate	38	41	45	41
Primary	24	12	10	15
Secondary	38	30	40	36
Higher secondary	–	17	5	7
Livestock (No.)[a]				
Cow	4 (40)	1 (20)	4 (30)	1
Goat	3 (30)	–	8 (20)	1
Poultry	10 (40)	11 (60)	15 (50)	6
Landholding (decimal)[b]				
Homestead	56 (3)	86 (6)	31 (3)	65 (4)
Homestead forest	142 (8)	151 (10)	160 (14)	149 (10)
Jhum	662 (37)	460 (30)	528 (46)	545 (37)
Agriculture	227 (13)	500 (32)	60 (5)	245 (17)
Fruit garden	250 (14)	172 (11)	230 (20)	210 (14)
Plantation	400 (22)	106 (7)	125 (11)	213 (14)
Bamboo grooves	50 (3)	67 (4)	20 (2)	54 (4)
Total	1787	1542	1154	1481
Income (BDT) in 2011 and sources[b]				
Homestead forest	33000	39338	14750	29030 (13)
Jhum	84500	125000	42500	84000 (38)
Agriculture	34000	2000	–	12000 (6)
Fruit garden	36500	54215	16500	35738 (16)
Plantation	28000	42148	14000	28049 (13)
Livestock	4000	5100	2000	3700 (2)

(continued)

Table 6.2 (continued)

Variable	Pagli nichu para	Pagli middle para	Pagli upor para	All three paras
Business	10000	19000	24000	17667 (8)
Remittance	–	4500	8000	4167 (2)
Service	1200	12000	–	4400 (2)
Medicinal plants	–	1500	150	550 (0.3)
Mean annual income (BDT)	231500	304801	122550	219617

[a]Figures in parenthesis indicate percentage of households
[b]Figures in parenthesis indicate percentage of total land

6.6.2 *Jhum: Principal Farming Practice in the Study Areas*

Like in other parts of CHT, all participants in the study site have long been practicing jhum, a traditional agroforestry practice. They grow a variety of crops including trees, horticultural crops, and vegetables in jhum. Species composition, density, and their frequency (percentage of agroforestry plots having a species) of 30 agroforestry plots are shown in Table 6.3. Plant species composition shows that commonly grown tree species are teak (59 %), gamar (44 %), silkoroi (30 %), and bamboo (15 %). Of the trees, 52 % participant's plots have 1–30 (mean 14) trees/plot and 30 % have 30–60 (mean 49) trees/plot. Dominant fruit species consist of litchi (48 %), am (26 %), kanthal (22 %), guava (19 %), and lebu (19 %). Fifty-two (52) percent plots have 1–30 trees (mean 14)/plot, and 19 % plots have a mean of 38 tree/plot. Around 30 % plots do not have fruit trees. Commonly grown vegetables are turmeric (63 %), papaya (48 %), banana (41 %), and sajna (37 %).

It was found that 52 % participants grow 4–6 crops on their plots followed by 7–8 species by 22 % participants and 15 % participants with more than eight (08) species. Only 11 % participants grow 2–3 species on their plots. It we observed that participants plant trees sporadically and do not maintain a proper spacing and arrangement of component crops. Therefore, after several years when trees grow up, they could not cultivate agricultural crops and shift to another plot. Moreover, they cultivate crops such as turmeric and ginger along the slope which creates soil erosion and nutrient loss during rainy season. Due to soil erosion and loss of soil fertility, they cannot grow agricultural crops on the same plot every year.

We explored several merits and demerits of jhum as shown in Fig. 6.2. All participants mentioned jhum as traditional form of agriculture and easy to follow, while 93 % commented that planting martials for jhum are locally available. They can harvest products from jhum 3–4 months of sowing (73 %) and require low maintenance cost (40 %).

On the other hand, 83 % participants pointed out that productivity of jhum seems decreasing (83 %), having little profit margin (77 %), requires more fertilizers and pesticides (60 %), thereby increasing the input cost. They (57 %) also argued that government agencies such as forest department and agricultural department discourage jhum, causing deforestation and land degradation (47 %),

Table 6.3 Density and frequency of plant species found in agroforestry plots

Crops	Local name	Scientific name	Density (stems/ha)	Frequency (%)
Trees	Teak	*Tectona grandis*	7.87	59
	Gamar	*Gmelina arborea*	3.54	44
	Silkoroi	*Albizia procera*	3.15	30
	Kala Koroi	*Albizia lebbeck*	1.18	4
	Bhadi	*Garunga pinnata*	5.91	4
	Chickrassi	*Chickrassia tabularis*	1.18	4
	Shimul	*Bombax ceiba*	4.72	4
	Bamboo	*Melocanna baccifera*	5.51	15
	Cane	*Calamus spp.*	3.94	4
Fruit	Litchi	*Litchi chinensis*	3.94	48
	Am	*Mangifera indica*	1.57	26
	Kanthal	*Artocarpus heterophyllus*	3.15	22
	Guava	*Psidium guajava*	4.72	19
	Lebu	*Citrus medica*	2.36	19
	Jambura	*Citrus grandis*	3.54	11
	Orange	*Citrus reticulatus*	2.36	4
	Jam	*Syzygium grande*	3.15	7
	Lotkon	*Bixa orellana*	0.79	4
	Sofeda	*Manilkara achras*	0.79	4
	Boroi	*Zyzyphus mauritiana*	1.97	11
	Painnagula	*Flacourtia cataphracla*	7.87	4
Vegetables	Halud	*Cuurcma domestica*		63
	Papya	*Carica papaya*		48
	Banana	*Musa sapientum*		41
	Sajna	*Moringa pterygosperma*		37
	ComillaKachu	*Colocasia esculenta*		26
	Ada			15
	Brinjal	*Solanum melongena*		11
	Lao	*Lagenaria siceraria*		11
	Chalkumra	*Beninca sahispida*		7
	Tulsi	*Ocimum sanctum*		7
	Potato	*Dioscorea alata*		4
	Marich	*Capsicum annum*		4
	Lalshak	*Amaranthus tricolor*		4
	Mulashak	*Raphanus sativus*		4
	Olkachu	*Colocasia spp.*		4
	Potol	*Trichosanthes dioica*		4
	Kumra	*Cucurbita maxima*		4
	Jinga	*Luffa acutangula*		4
	Gachalo	*Glinus lotoides*		4

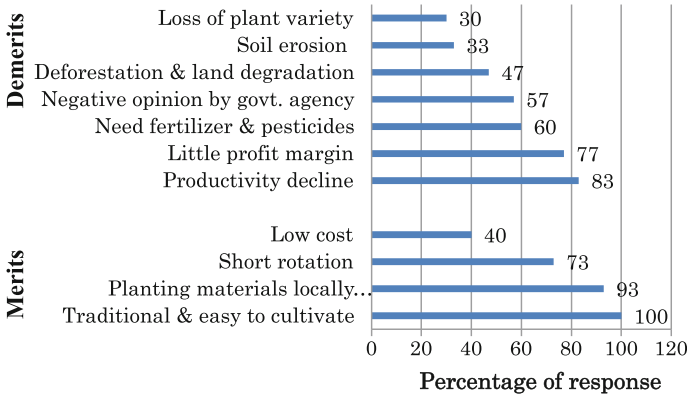

Fig. 6.2 Participant's opinion on merits and demerits of jhum

soil erosion (33 %), and loss of local crop variety (30 %) due to planting of only economically profitable varieties.

6.6.3 Project Objective(s) and Implementation Approach

The objective of the project was poverty alleviation and environmental enrichment of the locality through development of appropriate agroforestry system(s) with active participation of local community. The knowledge gathered from the project would help for developing policy recommendations for sustainable land uses in the Chittagong Hill Tracts.

6.6.3.1 Project Implementation Approach, Site, and Participants Selection

From the discussion with project investigators and participants, it was confirmed that a community-based participatory approach (Fig. 6.3) was followed to implement the project activities. The project authority obtained funding and has technical knowledge to implement the project activities. However, project investigators felt that working with tribal people in the CHT is challenging because they have very little trust in plain land people which has been inherited in their mind due to continuous exploitation by plains for long time. Therefore, it is very important to create trust, networks, and committee among them which are considered as social capital. Here, we explain how project investigators proceed to select project participants and create social capital among them [participants].

At the very beginning, project investigators asked officials of Hill Flower, a local NGO with whom they worked for natural resource management in Rangamati, to

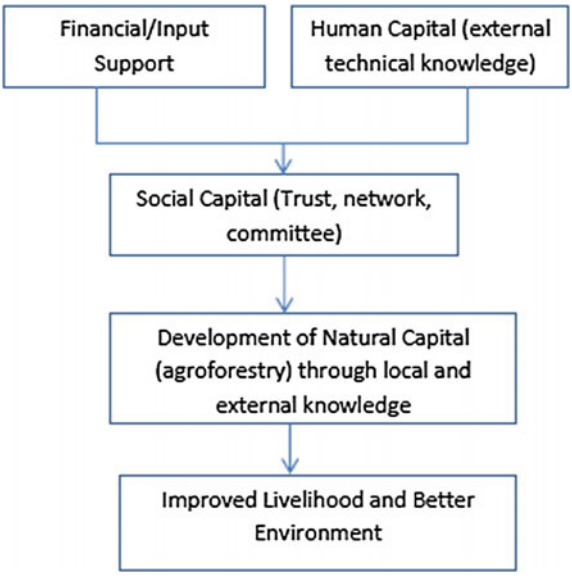

Fig. 6.3 Project implementation approach

select a tentative site where the project could be implemented. Officials of that NGO suggested selecting Wagga union of Kaptai Upazila because the site is accessible and there are development activities in the site implemented by government organizations and NGOs. Then, investigators hold a small meeting with some villagers in the presence of Hill Flower officials and Wagga high school teachers; explained the intention of project; and asked them whether they are interested to join. In order to discuss about the project, the investigators proposed to hold a larger meeting with all villagers if they are really interested to join and obtain project benefits.

After one week of first meeting, they hold a big gathering with all villagers. Faculty members of IFESCU, officials of Hill Flower, and some teachers of Wagga high school attended the meeting. The investigators described the objectives of project, said about supports that project can provide to participants and what the participants would need to contribute to project. The participants are needed to allocate one acre of jhum land and labor for agroforestry development. They will enjoy all benefits generated from the agroforestry plots. Faculty members, officials, and teachers explained the importance of agroforestry for livelihood and environmental improvement. The participants also actively joined in the discussion. At the end of meeting, the investigators asked villagers to select 30 participants who are interested to join, can allocate one acre of jhum land, and willing to develop agroforestry plot. Field officer of the project who is a local tribal man coordinated with villagers for the selection of participants. They were also asked to select agroforestry plots where project activities could be executed.

A series of meetings were held afterward, and continuous interactions helped to create trust in their mind that project authority really wanted to work with participants for agroforestry development, thereby enhancing their livelihood and

environment. During participant selection, some villagers who live in interior (2.5 km from main road) complained that most of development projects in the area are being implemented in nearby road and they are deprived of development. The project authority ensured that participants would be selected from all villagers. Considering available project resources, 30 participants were selected as project beneficiaries in three villages.

6.6.3.2 Development of Agroforestry

After the preliminary selection of agroforestry plots by the participants, project investigators, faculty members of IFESCU, and agricultural officers of Kaptai Upazila visited all plots for assessing suitability for agroforestry development. About 10 plots were found unsuitable because of steep slope and suggested to choose other sites. Agroforestry is suitable for land with moderate hill slope. Participants were asked to prepare plots for planting agroforestry crops. Faculty members of IFESCU and Kaptai Upazila agricultural officers briefed them how to prepare land. They dug a pit of 1.5ft × 1.5ft × 1.5ft with a spacing of 18ft × 18ft (plant to plant and row to row).

Crop combination of agricultural and fruit species was selected based on participant's preferences. By using a participatory scoring technique, we assessed participant's preference on priority species (Table 6.4). The preferred species are malta, komola, mango (Amropali variety), litchi (China-3 variety), and bel. Those were planted together with traditional agri-crops such as turmeric, papaya, banana, sajna, comilla kachu, ada, brinjal, lao, and chalkumra; forest tree species such as teak, gamar, silkoroi, kala koroi, and shimul; and other fruit species.

Selection of species was based on four broad criteria (aspects): (a) market, which is further divided into four criteria, i.e., market potential, market competition, knowledge and capital needs for cultivation, and profitability; (b) ecological aspects, i.e., resource availability, multiple use, period of cultivation needed before harvest, harvest period, and renewability; (c) social aspects, i.e., benefit sharing, income generation, indigenous knowledge about plants and products, potential for employment, and gender division; (d) techniques needed—technology required—existing technology, processing needs, and capacity for processing.

They perceived that these species are economically profitable, ecologically viable, and socially acceptable. Perceptions about the value of five priority fruit tree species are given in Table 6.5. A total of 120 seedlings per participant were supplied for planting in one acre of agroforestry plot.

According to original project proposal, three (03) agroforestry systems considering composition and tree density were supposed to be developed. But participants requested to have had similar system for all of them. Hence, project authority established an agri-horti-silvicultural type of agroforestry system (Plate 6.1). In each selected village, ten individual agroforestry plots (one acre each) were established. For cultivating agricultural crops, participants were motivated to establish soil strips across the slope so that soil erosion has reduced and water-holding capacity has increased. Participants used to cultivate agricultural crops along the slope. They

Table 6.4 Participatory scoring values indicating participants' preferences for various species

Name	Scientific name	Family	MA	EA	SA	TA	Mean score
Am	*Mangifera indica*	Anacardiaceae	2.3	2.0	2.1	1.7	2.02
Litchi	*Litchi chinensis*	Sapindaceae	2.5	2.1	2.0	1.8	2.10
Komola	*Citrus sinensis*	Rutaceae	2.7	1.9	2.1	2.0	2.18
Malta	*Citrus spp.*	Rutaceae	2.8	1.9	2.1	2.0	2.20
Bel	*Aegle marmelos*	Rutaceae	1.8	2.0	2.0	1.7	1.88

Note MA, EA, SA, and TA mean market aspect, ecological aspect, social aspect, and technological aspect respectively. Figures are the average of three scales: 3 being the highest, 2 medium, and 1 the lowest

Table 6.5 Priority fruit tree species and their corresponding value as perceived by the participants

Species	Reason for choose
Mango	Good market value of fruits, due to the application of optimum insecticide fruits have higher demand in city dwellers; productivity is relatively high compared to other region; soil condition is suitable for mango tree
Litchi	Fruits ripen earlier compared to other region and hence fetch higher market price, productivity is high, and propagation method is easy
Komola	Produce only in hills, soil condition suitable, good opportunity in our market, and suitable species for agroforestry because it requires minimum space for growing
Malta	A new fruit in CHT, grow well, productivity is also good, good opportunity in our market, and suitable species for agroforestry because it requires minimum space for growing
Bel	Good market value of fruits, productivity is high, seedlings are available, and medicinal use

were also motivated to grow agricultural crops every year in agroforestry plots. They used to cultivate agricultural crops in every alternate year. Input such as fertilizer, seed, seedlings and technical supports were given from project.

6.6.3.3 Monitoring of Agroforestry Plots

Project investigators, faculty members of IFESCU, research students, project field staff, and monitoring team members of BARC regularly monitor the performance of agroforestry plots (Plate 6.1). In each village, an agroforestry committee was formed by involving *karbari* (leader of village) and community people. The committee is actively involved in the project for its effective implementation. Project investigators hold regular meetings with participants and visit agroforestry plots every month. Due to continuous monitoring by several stakeholders, it was possible to identify problems (if any) earlier and hence took measure accordingly. Because of continuous interactions with scholars, participants benefited in various ways. They learned about new farming system and form networks and seek farming-related advice when needed.

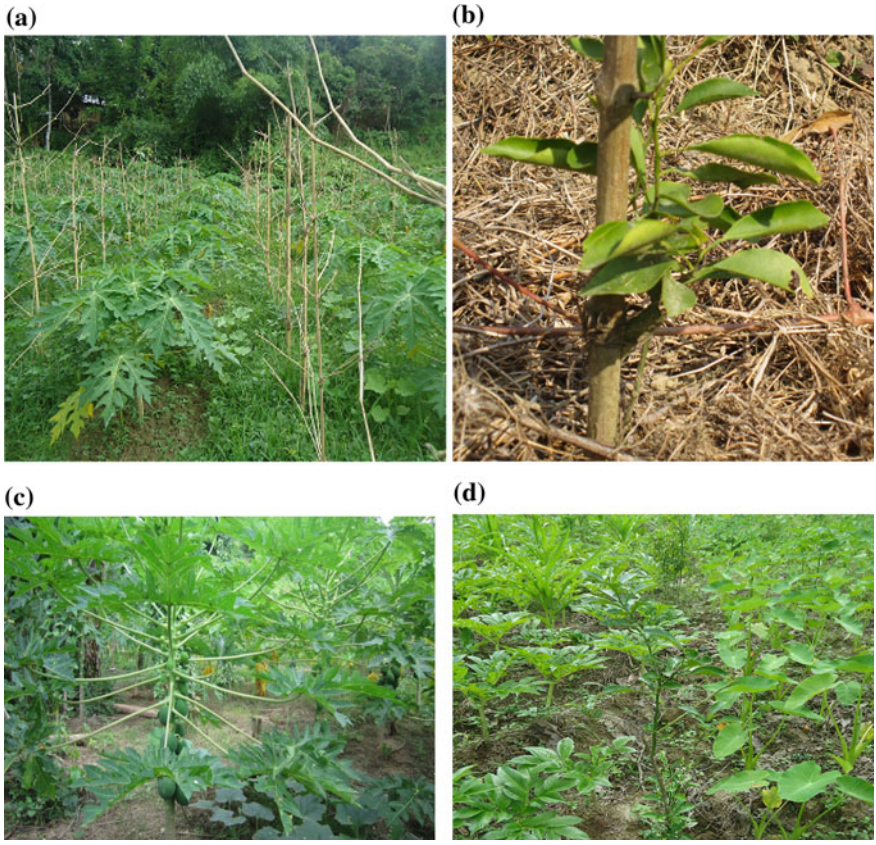

Plate 6.1 Agroforestry plots in the project site. **a** A multi-layer agroforestry plot. **b** A growing Malta seedling mulched with dry straw. **c** Agroforestry products. **d** An agroforestry plot

6.6.4 Performance of Developed Agroforestry System

As mentioned earlier with active participation of participants, faculty members of IFESCU, and experts of agricultural office, an agri-horti-silvicultural agroforestry system was developed. Agroforestry plots were established in September–October 2011. In order to assess the growth and survival of planted seedlings, we counted existing seedlings in July 2013. We measured total height of seedlings in July 2012 and July 2013. We assessed survival of planted fruit's seedlings planted in flat land as well as in moderate slope land. The results are summarized in Table 6.6, and it shows that higher percentage of survival is for BARI Aam 3 (77 %) followed by China 3 litchi (71 %), orange (61 %), and malta (54 %).

Growth performance of planted fruit seedlings in the study area shows higher current annual increment (CAI) of 25 cm (in terms of height growth) for orange followed by 22 cm for mango and 15 cm for malta and 13 cm for litchi (Table 6.7).

Table 6.6 Survival percentage of planted fruit seedlings in the 30 AF plots

Name of the species	Survival percentage in flat land (%)	Survival percentage in moderate slope (%)	Mean survival percentage (%)
Mango (BARI Am 3)	76.81	77.39	77.1
Malta	55.21	53.48	54.34
Orange	56.08	65.07	60.57
Litchi (China 3)	66.56	74.85	70.70

Table 6.7 Height growth of major planted fruit species in the AF plots

Species	Seedling height (cm)		CAI (cm)	Minimum height (cm)	Maximum height (cm)
	2012	2013			
Mango (BARI Aam 3)	79	101	22	26	220
Litchi (China 3)	55	68	13	16	146
Malta	43	58	15	14	117
Orange	44	69	25	11	204

Height measurement of the planted seedlings showed greater variation in minimum and maximum heights ranging from 26–220 cm for Mango to 14–117 cm for Malta (Table 6.7). It means that mango is better suited to the site conditions than other species.

We also examined yield of agricultural crops and collected data on cost incurred in cultivation of agricultural crops and benefits obtained from the sale of agricultural products. Participants were used to cultivate agricultural crops in a plot every alternate year. They said that if they cultivate vegetables every year, then the productivity will be very low. The other reason is that as they have enough land to cultivate compared to plain land, they are more reluctant to grow crops in the same piece of land sequentially.

The project investigators motivated them to cultivate different vegetables in their AF plots ever year. They were in dubious whether they will obtain similar or more benefits if they cultivate the land sequentially, but they finally grew some vegetables. The major crops they have grown in their plots include ada (ginger), mukhikachu (eddoe), halud (turmeric), and some other crops such as seem (hyacinth bean), dhania (coriander), mistikumra (sweet pumpkin), jhinga (ribbed gourd), puishak (Indian spinach—green), begun (brinjal), dhonepata (coriander), chicinga (snake gourd), olkochu (eggplant foot aroid), and cassava. Table 6.8 shows the mean earning from the sale of different crops in the AF plots. It is seen that each participants earn an amount of BDT 56,750 as net benefit per year from agri-crops as an additional benefit while their planted fruit trees continue to grow. In case of agricultural crops, they earn higher net benefits from mukhikachu (24 %) followed by aada (15 %), dhonepata (10 %), lebu (9 %), and so on (Table 6.8).

Table 6.8 Benefit–cost analysis of component cropsgrown in the AF plots (values in the parentheses denote percentage of total)

Strata	Component crops	Cost (Tk.)	Benefit (Tk.)	Net benefit (Tk.)	B/C ratio
Understory	Aada (ginger)	7132 (25)	15680 (18)	8548 (15)	**3.03**
	Anaras (pineapple)	–	240	240	
	Begun (brinjal)	172	3440 (4)	3268 (6)	
	Dheros (okra)	28	1584	1556 (3)	
	Dhonepata (coriander leaf)	147	5872 (7)	5725 (10)	
	Holud (turmeric)	4460 (16)	6320 (7)	1860 (3)	
	Jhinga (ribbed gourd)	36	2800 (3)	2764 (5)	
	Mukikachu (eddoe)	3928 (14)	17440 (21)	13512 (24)	
	Chicinga (snake gourd)	18	340	322	
	Korolla (bitter gourd)	214	2620 (3)	2406 (4)	
	Mistikumra (sweet pumpkin)	31	956	925	
	Morich (chili)	36	3640 (4)	3604 (6)	
	Olkochu (eggplant foot aroid)	328	1608 (2)	1280 (2)	
	Pan-aloo (air potato)	92	955	863	
	Puishak (Indian spinach)	7	84	77	
	Shim (hyacinth bean)	6	2200	2194 (4)	
	Shosha (cucumber)	25	600	575	
Middle story	Cassava	–	–	–	
	Kola (banana)	–	–	–	
	Lebu (lemon)	1032 (4)	6200 (7)	5168 (9)	
	Pepe (papaya)	11	4280 (5)	4269 (8)	
	Peyara (guava)	188	2420 (3)	2232 (4)	
Upper story	Bel (local variety)	–	–	–	
	Litchi (local and China 3)	118	3600 (4)	3482 (6)	
	Malta (sweet orange)	–	–	–	
	Mango (Bari Aam 3 and 8)	–	–	–	
	Komala (orange)	–	–	–	
	Sajina (drumstick)	–	1880 (2)	1880 (3)	
	Segun (teak)	–	–	–	
	Supari (beetle nut)	–	–	–	
Other costs (plowing, weeding, fertilizers, pesticides, etc.)		10001 (36)	–	−10001	
Total		**28009 (100)**	**84759 (100)**	**56750 (100)**	

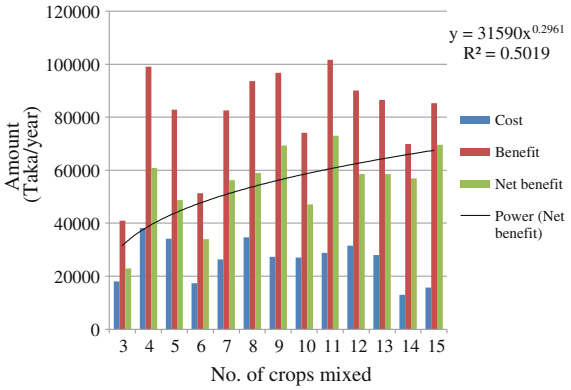

Fig. 6.4 Benefit–cost analysis of the developed agroforestry system

Most of the participants maintain a multi-story production system consisting of vegetables, spices, and fruits (Plate 6.1). The upper story consists of trees and fruit species; middle story with shrubs such as papaya, banana, lebu, and guava; and understory with different vegetables.

It is interesting to see that the participants grow as many as 15 crop varieties in their agroforestry plots for their own use or sell in the market to get extra income. Benefit–cost analysis shows an increasing net benefit with number of crop varieties used in the production system (Fig. 6.4) and having a benefit–cost ratio of 3.03 (Table 6.8). This benefit–cost ratio indicates that even though planted fruit species are yet to bear fruits, participants get almost three times benefits from agricultural crops. Thanks to guidance from project authority, the participants are happy with the production system.

6.6.5 Participants' Perception on Project Benefits and Sustainability of Agroforestry

Participants' are optimistic about the project benefits. Analyzing the data gathered on participants' perceived immediate benefits from the project (Fig. 6.5), it is found that most of the participants' believe that agroforestry will assist to restore forest resources and associated values (73 %) followed by enhancing water availability in the locality (60 %); acting as source of additional income, food stuff, and timber within a land (57 %); restoring productivity of degraded lands (50 %); improving living standards (40 %); reducing soil erosion (27 %); reducing the frequency of fertilizer use (17 %); and contributing to the improvement of national economy

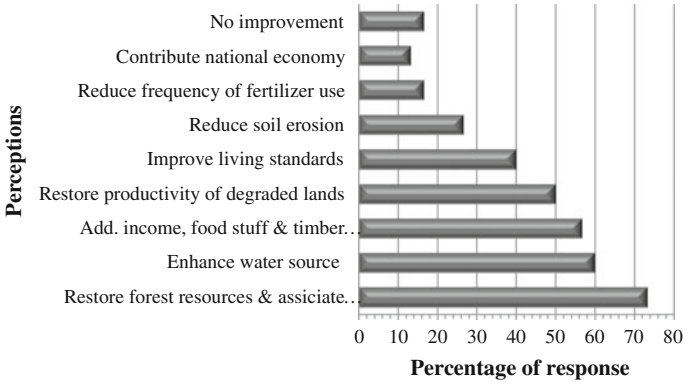

Fig. 6.5 Participants' perceptions on project benefits

(13 %), but still a few of the participants (17 %) opined that there will be less possibility in improvement of overall livelihood condition because agroforestry is a long-term practice where they can get additional income from crops only within the first 3–5 years before the plots develop into tree-covered area halting the crop production from that plots.

The overall perception of the participant was found very high as they are found very keen to invest their own resources (land, labor, time, money) for this project. The participatory and incentive-based approach also motivated them to participate actively in the project. Considering the sustainability of the new AF system, most of the participants (54 %) opined that they will continue this system on the existing plot and surrounding areas even after the end of the project followed by 27 % participants who want to continue this system on the existing plot and only a few participants (3 %) who do not want to continue this system (Fig. 6.6). They also believe that this project will give them an opportunity to establish strong networks with government officials, researchers, academicians, and extension agents to discuss and solve any problem related to their farming system, livelihood strategy, and social development.

6.6.6 Participants' Participation in Project Activities

The agroforestry project aimed to involve local people effectively in the development of agroforestry system. Although we have discussed their participation in project activities in earlier sections, here we summarize the level of participation in concise manner. We observed that the project investigators hold meetings with participants before implementing any project activities in the project sites. They

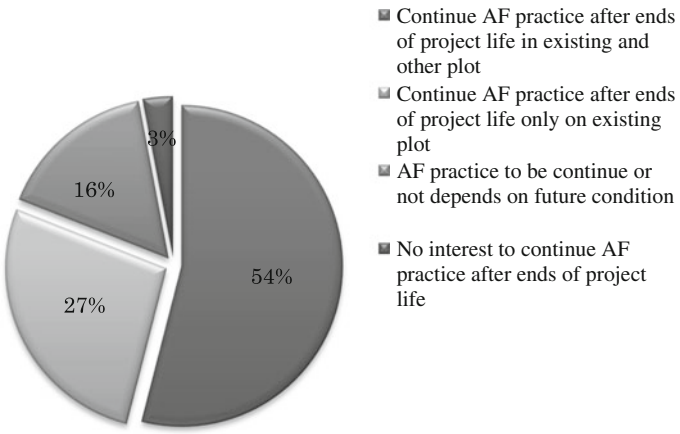

Fig. 6.6 Participants' opinion on sustainability of agroforestry

seek participant's involvement in implementing activities. Table 6.9 summarizes the level of participation of participants in the project activities.

6.6.7 Challenges and Opportunity

The project authority has experienced several constraints in implementing the project activities. Some are related to project site and behavior of participants, while others are related to project coordinating authority. Even though project investigators tried their best to motivate participants to follow the suggested farming practices, some of them did not follow all these suggestions. For examples, project authority suggested digging 1.5 ft × 1.5 ft × 1.5 ft pits, but some of them dug a tiny pit with single spade hit. Some participants did not grow agricultural crops across the slope and follow rotational cropping for cultivating agricultural crops. Even some of them planted some of supplied fruit seedlings outside the selected agroforestry plots.

There are opportunities to work with tribal people and promote agroforestry in the CHT. If motivated and build trust, tribal people are interested to work in collaboration with plain land people. In the CHT, there are large tracts of degraded moderate slope land that can be brought under agroforestry. However, several measures need to follow when implementing any projects. These include the following: (1) forming small groups, (2) concentrating on activities in small areas rather than sparsely distributing inhabitation, (3) providing hands-on training and guide activities very closely, and (4) involvement of local partners.

Table 6.9 Level of participation in the agroforestry project development and implementation

	Project activity	Evidence of participation
1	Inception of project	Project authority holds several meetings with participants, local leaders, NGO staff, and local school teachers. Based on participants' consent, the project authority decided to implement project activities
2	Selection of participants	Villagers have selected 30 participants as project beneficiaries considering their willingness to join and work to develop agroforestry on one acre of their own jhum land. Project authority did not interfere in the selection process. We observed no conflicts among villagers due to this selection system
3	Selection of agroforestry plot	Participants' selected their plots with guidance from project staff and finally endorsed by project investigators and IFESCU faculty members
4	Selection of agroforestry system	Project authority was supposed to develop three agroforestry systems but participants wanted to have had similar system for all of them. Hence with their consent and expert's input, an agri-horti-silvicultural type of agroforestry system was developed for all
5	Choice of species	Selection of fruit species and agricultural crops for agroforestry was entirely done by the participants in consultation with project investigators. Planting materials of improved variety of selected species was supplied by the project
6	Resource contribution	Project authority supplied all planting materials, fertilizer and some labor cost. Participants' contributed land and labor—"in the spirit of self-help"
7	Monitoring and evaluation	Three agroforestry monitoring committees were formed involving participants' from each para, and a team leader was assigned from them. Team leader of each para monitor agroforestry plots of his members, discuss matters such as problems they face, and convey the message to project authority in the monthly meetings

6.6.8 Conclusions and Policy Implications

Tribal people usually remain fixed on their traditional methods of cultivation. The participatory approach, continuous motivation and interactions with researchers, active participation, and colearning have encouraged them to develop improved farming techniques. Even though they were used to plant seedlings in a tiny pit made by a single spade hit, now most plant in large pit (1.5 ft $\times$ 1.5 ft $\times$ 1.5 ft). They maintain wider and specified spacing, raised earth mounds and used mulch around tree bases, and cultivated agricultural crops on AF plots every year across the slope. Continuous interactions, communications, and motivation helped to build trust in participants and now most of them follow project investigators' and researchers' recommendations of agroforestry management. With this agroforestry system, they can grow agricultural crops every year and earn at least three times higher income.

Shifting cultivation was once a sustainable land use in mountainous regions. It is no longer considered sustainable. One of the principal reasons for non-sustainability is the repeated shortening of fallow periods. People in these regions now face food shortages and often suffer from malnutrition. The short fallow period also causes land degradation. In order to solve the problems of food scarcity and land degradation, agroforestry that combine agricultural crops along with woody and non-woody perennials is being extensively promoted in the mountainous regions. Agroforestry systems have become increasingly important as they offer the prospect of producing woody perennials for bioenergy on the same land area as food and/or fodder plants, while enhancing overall biodiversity (Nerlich et al. 2013). Bucagu et al. (2013) recommended that high-value trees including fruit-tree-based agroforestry are popular in highland areas and play a complementary role with other activities in the subsistence farming system, contributing in increasing the total productivity and food security in the communities.

Recent development discourse suggests that in the absence of stakeholder's participation, development projects cannot be successful and not possible to attain the goals of development interventions. (Blay et al. 2008; Pomeroy and Douvere 2008; Bell et al. 2012; Luyet et al. 2012). This study found that participants could be involved actively from inception through monitoring of project activities. The project accommodated participants' ideas and choices during implementation. The study shows that the project investigators not only involved participants in project activities but also arranged field trainings that provide hands-on knowledge on crops management and pest and disease controls. Further, it helped to develop networks with researchers and research organizations from which the participants obtain advices for their farming practices. Meghan et al. (2008) indicated that the long-term success of agroforestry development programmes may be highly influenced by farmers' capacity to manage the agroforestry systems which may increase the likelihood that they would maintain practices into the future.

Population growth, increasing trend of cultivation of soil exhausting root crops along the hill slope, continuous deforestation, and shifting cultivation with very short fallow period impose serious environmental problems on the hills of CHT. Growing of root crops causes soil erosion, and loss of soil fertility and land becomes degraded. In this adverse land condition, agroforestry can play a role in improving soil fertility, increasing crop productivity, and reducing food insecurity in the region. However, a coordinated approach is needed to promote agroforestry practices. We suggest the following policy implications for the sustainable intensification of agroforestry in shifting cultivation areas of Chittagong Hill Tracts:

1. A shift away from cultivation of ginger, turmeric, and arum along upper hill slopes.
2. The promotion of appropriate agroforestry practices in degraded and abandoned shifting cultivation areas with active participation of farmers, though noting that agroforestry cannot be implemented on steep hill slopes.

3. The arrangement of the necessary institutional, technical, and financial support with local partners including tribal organizations, NGOs, department of agriculture, horticulture, and forest department.
4. The Chittagong Hill Tracts Development Board (CHTDB) should play a leading role in cooperation with research organizations, the forest and agriculture departments, hill districts councils, and local NGOs to develop site-specific appropriate agroforestry systems and their promotion through mass awareness creation among the tribal people.

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Chapter 7
Toward Sustainability of Community-Based Forest Management

This chapter illustrates a comparative scenario of four CBFM interventions in terms of socioeconomy, forest attributes, and legal, social, management and resource system-related characteristics. Socioeconomic attributes reveal that villagers in respective area depend on forest resources (fuelwood, bamboo, timber, leaves, sungrass, vegetable) for cooking energy, house construction materials, food, and household income. Both VCF and Chunati PA are rich in plant species composition (consisting of more than 90 species), but tree density is highest in Betagi–Pomra CF (1164 trees/ha). Individual land ownership in Betagi–Pomra CF encouraged villagers to plant fast-growing and high-yielding tree species. Individual ownership, users' management rights, well-defined boundary, small resource system, and social equality ensure relatively more sustainable management of forests in Betagi–Pomra CF, VCF, and AF projects than that of Chunati PA. Some policy implications are suggested for sustainability of various CBFM approaches, and recommendations are made to incorporate REDD+ schemes, introducing mutual rotating fund and collaboration of corporate agencies in CBFM.

7.1 A Comparative View of Socioeconomy and Forest Dependency

The villagers in all study areas are predominantly farmers practicing agriculture mostly on leased land as well as on their limited own land. The agricultural practices include shifting cultivation in hilly areas and rain-fed and irrigated agriculture in plain land. However, in Chunati PA, villagers have very limited agricultural land, and hence, they are engaged with other economic activities including daily wage labor, small village business, and working in garment industries. In case of Betagi–Pomra CF, villagers have diversified their economic endeavors including local business and service in local schools and public institutions. Dependency on

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Table 7.1 Villagers' socioeconomy and forest dependency in four CBFM study sites

Variable	B-P CF	VCF	AF project	Chunati PA
Occupation (%)				
Farmer	49	100	100	40
Daily labor	11	30	–	28
Business	14	25	30	12
Service	18	26	7	8
Others	8	6	–	12
Mean annual income (BDT)	160,875	91,666	219617	67404
Income from forest products (BDT)	28,604 (18)[a]	24,137 (26)[b]	56750 (26)[c]	7620 (13)[d]
Dependency on forest	Moderate	Moderate	Low	High
Cooking energy source				
Firewood	100	100	100	100
Cylinder gas*	20	–		–
Improved cooking stove*	–	–	–	20

Note B-P CF (Betagi–Pomra CF); values in parenthesis denote percentage of mean annual income
*They also use firewood but less amount
[a]Income from selling of forest products
[b]Market value of forest products consumed by villagers
[c]Income from selling agricultural products from agroforestry plots
[d]Income from selling forest products except own consumption

forest resources for earning as well as household consumption is high in Chunati PA although contribution of forest products to household income is the lowest than other interventions (Table 7.1). Villagers in AF project produce agricultural crops which have continuous market demand, and hence, they have the highest income from agroforestry products and hence low dependency on forest products. Kibria et al. (2015) also reported that the indigenous people in the CHT obtain higher revenue from agroforestry than that of other land uses including the VCF and shifting cultivation.

In VCF, villagers collect forest products for their own use and these products worth a market value equivalent to 26 % of mean annual household income, and so they claim a moderate dependency on forest resources apart from other ecosystem services mainly of perennial water supply. Villagers across the four CBFM areas use fuelwood for cooking purposes. In Betagi–Pomra CF area, 20 % households use cylinder gas, and in Chunati PA, 20 % households use improved cooking stove provided by GIZ project. The use of cylinder gas and improved cooking stoves might reduce the consumption of fuelwood in these areas and thus would help to conserve forest resources.

7.2 Contrasting Features of Forests in Fours CBFM Sites

Among four CBFM sites, the VCF and Chunati PA represent secondary (natural) forests, while Betagi–Pomra CF consists of plantations on degraded land and AF project comprises newly established agroforestry on shifting cultivation areas. Being secondary natural forests, both VCF and Chunati PA have rich tree diversity consisting more than 90 tree species in each site (Table 7.2). Villagers in Betagi–Pomra CF sites grow diversified trees including timber, fruit, and fuelwood species. In AF project, villagers cultivate about 30 crops including vegetables, fruits, and timber species. Being plantations, the Betagi–Pomra CF forests have higher tree density (1164 trees/ha) than other CBFM sites. Although current forest productivity in terms of basal area and above ground biomass is higher in the VCF than other CBFM sites (Table 7.2), villagers claim that the trends of forest productivity have been decreasing in the VCF. They mentioned that cutting of trees by outsiders is a serious threat to VCF. Due to continuous support from several development projects, the forests of Chunati PA seem improving somewhat though its sustainability can be assessed with future forest conditions when project support ends. The forests of both VCF and Chunati PA have potential natural regeneration which if managed well can accelerate good forest growth.

Table 7.2 Attributes of forests in four CBFM study sites

Variable	B-P CF	VCF	AF Project	Chunati PA
No. of species	35	94	30	93
Density (tree/ha)	1164	255	270	239
Basal area (m^2/ha)	5.09	7.84	–	2.64
Above ground biomass (tree/ha)	41.25	59.82	–	33.30
Dominant species	*Tectona grandis, Gmelina arborea, Artocarpus heterophyllus, Swietenia mahagoni*	*Callicarpa arborea, Aporosa wallichii, Macaranga denticulata, Eurya acuminate, Macaranga indica*	*Mangifera indica, Litchi chinensis, Citrus sinensis,Aegle marmelos*	*Acacia auriculiformis, Dipterocarpus turbinatus, Ficus hispida, Tectona grandis, Shorea robusta, A. mangium*
Regeneration				
No. of species	–	43	–	74
Density	–	65,287	–	76,471
Bamboo		26,394	–	47,414
Trends of forest productivity	Increasing	Decreasing	Increasing	Somewhat increasing

7.3 Legal, Social and Management Issues, and Resource System Characteristics

The legal, social and management aspects, and the characteristics of forest system all collectively affect the sustainability of forests. The legal issues considered here include land tenure, legal pluralism, rule formation, and links to higher governance (Table 7.3). Except in AF project site, the land tenure system in other three sites is held in state along with some extend of individual tenure. In case of Betagi–Pomra CF project, the participants have a lease of their plots for 99 years, while in Chunati PA, many villagers claim to have their own parcel of land inside the protected area. On the other side, the forest department claims that villagers illegally occupied large tracts of land inside the protected areas. Even though the state holds the forest land in Chittagong Hill Tracts, the VCF is owned communally by the indigenous people. Nonetheless, they have no legal documents for this claim and hence remain in fear of state acquisition of VCF land. The rules for resource use and management and their modifications if necessary are made in consultation with relevant stakeholders including forest department in the cases of VCF, B-P CF, and AF project.

Table 7.3 Legal, management and social issues, and resource system characteristics of four CBFM practices

Variable	B-P CF	VCF	AF project	Chunati PA
Legal issues				
Land tenure	Individual, state	Communal, state	Individual, communal	State, individual
Legal pluralism	Present	Present	Present	Present
Rules formation	In coordination	In coordination	In coordination	State
Power to modify rules	In coordination	In coordination	In coordination	State
Links with higher governance	Medium	Medium	Low	High
Management issues				
Management authority	User	User	User	State in coordination
Forest monitoring	User, regular, effective	User, regular, effective	User, regular, effective	State, irregular, ineffective
Harvesting rights	Allowed	Allowed, limited	Allowed	Restricted
State/external support	Medium	Low	Low	High
Local acceptance	High	High	High	Medium

(continued)

Table 7.3 (continued)

Variable	B-P CF	VCF	AF project	Chunati PA
Social issues				
Equity	Equitable	Equitable	Equitable	Less equitable
Networks	Good	Good	Good	Good
Conflicts management	Locally, easy	Locally, easy	Locally, easy	Complex
Elite capture	Low	Low	None	High
Resource system				
Size of resource system	Small	Small	Small	Large
Dependency on resource system	Moderate	Moderate	Moderate	High
Size of user group	Small	Small	Small	Large
Well-defined boundary	Clear	Unclear	Clear	Unclear
Heterogeneity of user groups	Homogeneous	Homogenous	Homogeneous	Heterogeneous
Sustainable evidence	High	Moderate	High	Poor

In case of Chunati PA, formation of rules and their modifications is done by the state agencies. The co-management committee (CMC) has very little power to influence. As a result, the elite capture is higher there in comparison with VCF, Betagi–Pomra CF, and AF projects. Being managed by the user groups, the villagers in VCF, Betagi–Pomra CF, and AF projects have equitable access to resources such as harvests, land which is less equitable in Chunati PA. Due to homogenous user groups, small resource system, and small size of user groups, it is easy to resolve any conflicts locally among villagers in VCF, Betagi–Pomra CF, and AF project sites. The external support in the VCF and AF projects is low, but local people accepted these forest management approaches highly because of environmental services and material benefits of these resource systems. Although the external support from international as well as national agencies is high in Chunati PA, the evidence of sustainability of resource systems seems poor because of high dependency of local people on resources, large heterogeneous user groups having high elite influences, less equitable access to resources, and complex nature of conflicts. Due to individual ownership, small manageable resources system with well-defined boundary, homogenous user groups, and moderate dependency of forests, the evidence of sustainability of forest resources is high in case of Betagi–Pomra CF and AF projects.

7.4 Toward Sustainability of CBFM

The "sustainability" is an ambiguous term that expresses any resource management would be sustainable if it is socially acceptable, economically viable, and environmentally suitable along with supportive enabling conditions including institutional support and good governance. The social, economic, and environmental factors are interrelated and cannot be viewed them independently. However, it is not easy to have equal share of these three factors in any system to make it a truly sustainable. Therefore, a cautious trade-off is needed among these factors to make a resource system sustainable. Mohammed et al. (2016) observed that coupling the social and ecological systems for sustainable environmental resource conservation is necessary for achieving sustainable community forest management.

In four different CBFM approaches described in this book, it was observed that local people involved with forests management are aware about the importance of their participation in terms of contribution to forest conservation, utilization of forest products, and other benefits derived from their engagement. These people are dependent on forest resources for most of their daily needs and hence feel encouraged to collaborate with agencies involved in forest management. As such, it can be claimed that the CBFM approaches have so far been accepted thankfully by the local people. Researchers, for example Moktan et al. (2015), reported that community management of forest is one of the emerging success models of state–community partnership on forest management to improve rural livelihood and forest conservation through people-centered approach to forest governance. Giving access and management rights over forest resources to local communities is expected to enhance livelihoods and other benefits of these impoverished people (Rahut et al. 2015).

Although local people are happy with their participation in the partnership, "equity" is a matter of concern. In Chunati PA, the participants do not have equal access to resources as well as in various committees. This unequal resource allocation and access might create frustration among participants which would jeopardize the objective of protected area co-management. The heterogeneity of user groups, lack of coordination among various committees, the absence of strong motivation from forest department staff for implementing co-management activities, and land tenure conflicts between forest department and local people impose serious social barriers on sustainability of co-management activities. The co-management committee has little influence on any decision related to forest management and setting income generation activities. The NGOs, empowered to implement co-management activities, usually take most of these decisions with some sorts of consultation with forest user groups. All of these constraints will apparently have negative influences on sustainable management of Chunati PA.

On the other hand, in three other approaches of CBFM, the participants have fairly equal access to resources and benefits. Being small and homogeneous user groups, they seemingly have no conflicts. The villagers manage VCF following customary land ownership but without any legal documentation. The absence of

legal instrument on communal ownership is a serious barrier for the sustainability of VCF as outsiders try to take this opportunity to exploit VCF. Although project villagers believe that they will enjoy the land tenureship for generation after generation, fragmentation of CF land due to separation of family members imposes a major threat on sustainability of CF in Betagi–Pomra CF project. The breakdown of nucleus family and the construction of buildings for growing population have fragmented forest land, and forest areas have apparently been declined. If the trends continue, it can be assumed that the forest areas would ultimately be occupied by the expanding inhabitants. Having above social constraints, then the question is whether capability, as Sen (1984, 2013) mentioned an important factor of sustainability, to manage forest resources in partnership with state and other agencies enough to sustain the system?

Looking at the economic aspect of sustainability, we find that the participants of AF and Betagi–Pomra CF projects obtain direct economic returns by selling forest products in addition to household consumption. These products include timber, fuelwood, and agricultural products. On the other hand, villagers can collect fuelwood, construction materials (e.g., bamboo), and non-wood forest products from VCF. Even though these products are used for personal purposes but bear opportunity costs which if not get from VCF must be paid by the villagers. In contrast, the villagers in Chunati PA do collect forest products although they have been discouraged to do so. They utilized these products mostly for household purposes. A portion of the villagers who are closely involved with PA co-management obtain alternative income generation (AIG) support from the projects. The GIZ project funding ended in the middle of year 2015, and the big question is how the villagers, who depend largely on forest land and forest products for their livelihood, would maintain AIG without project funding.

The villagers in all four CBFM sites are very much aware about the importance of environmental services of forests. Besides conserving local biodiversity, the VCF is a source of year-round water supply in the streams. Agroforestry conserves soil fertility and reduces soil erosion. The income from agroforestry products reduces peoples' dependency on nearby forests, thereby helping to conserve secondary forests. It also reduces the expansion of shifting cultivation areas as people obtain regular and steady income from agroforestry. Once barren, the hills in Betagi–Pomra CF project areas are now green with diverse trees and enriched with biodiversity. Due to co-management project, the forests in Chunati PA are regenerating and wildlife population have been increasing.

In all CBFM sites, there have been various types of institutional support from several agencies. The VCF is supported by a national NGO helping toward creating AIG so that dependency on forests would reduce. The AF project was supported by an academic institution for the development of suitable agroforestry model with active participation of villagers. This academic institution helped to link villagers with local research and extension agencies so that they would obtain technical support in future. Although the forest department established the Betagi–Pomra CF project, now it has almost no supervision. There have been several development projects in Chunati PA aiming at establishing local co-management structure,

livelihood improvement of local people, enrichment, and conservation of forests. The co-management structure built up has so far not fully able to mobilize local resources to form a strong and effective organization to lead the co-management activities. The committees formed at different levels have little coordination. Local staff members of forest department are not well aware about co-management and hence no distinct role on these activities. The funding agencies and their sister organizations in fact control all activities in consultation with forest department and local committees.

7.5 The Way Forward

The above description shows that the four different approaches of forest management have several positive and negative attributes of sustainability. There are several challenges in all CBFM approaches which warrant necessary policy interventions for their sustainability. In this section, we draw some specific policy implications for each of these CBFM approaches.

The VCF is owned traditionally by community without any legal instrument. This type of ownership needs to be acknowledged legally, and if so, then the villagers would manage the forests sustainably without any threat from outsiders. These forests can also be brought under a formal institutional framework. For this, a management wing can be established under the Chittagong Hill Tracts Development Board (CHTDB), the prime agency that looks after development activities and welfare of indigenous communities in the CHT, for the management of VCF. Collaboration will be needed among this VCF management wing, CHTDB, and the forest department so that villagers receive technical support from forest department and necessary funding from the CHTDB. This type of collaboration and institutional setup can also promote suitable agroforestry practices in favorable areas of the CHT. In that case, partnership will also be needed with agricultural and horticultural departments. In all cases, active participation of villagers, through their customary institutions, in the collaboration will be essential.

Land fragmentation due to expanding family population is a major threat to Betagi–Pomra CF project areas. The breakdown of joint families into individual families led to forest land division. The project needs to implement new agreements with project participants where restriction should be imposed not to expand buildings in forest areas and not allowing distribution of project land to family members. A regular monitoring by the forest department will be needed to execute these agreements.

The co-management of Chunati PA was funded by several development projects, and the last GIZ funding period ended in the middle of 2015. The participants lack ownership in the PA management and passively involved just with protection of forests. They do not have participation in PA management decision-making processes. Even forest department staff members have very little idea about co-management concept. Under such situation, it is necessary to provide training to

forest department staff on co-management and need to ensure that they would involve the participants effectively in PA co-management activities. If participants are engaged actively with due ownership, then it can lend the hope that the co-management of Chunati PA would endure with usual funding and a desired level of local governance could be maintained. Currently, a co-management committee (CMC) in each forest range oversees the management activities, and at forest beat level, there are no submanagement groups. In each of the seven forest beats at Chunati PA, a forest development committee (FDC) can be formed. The respective beat officer can act as a coordinator of each FDC, and a president from villagers can be selected. The interested villagers will be the members of each FDC. All seven FDC will be under the umbrella of respective co-management committee. The CMC in coordination with FDC representatives will take management-related decisions and delegate the FDC to implement the activities in respective forest beat. If this happened, then good governance could be maintained at local level and better management outcomes could be expected.

Except in agroforestry project site, villagers in other three CBFM sites are dependent on forest resources for their daily uses and income. In order to reduce their dependency on forests, opportunities should be explored for alternative income generation. Even though several development projects have introduced various AIG activities, continuation of these activities after project funding is a big question. In the following subsection, we recommend a few options.

7.5.1 REDD+ and the CBFM

It has been widely acknowledged that forests can only be conserved if minimum requirements of forest-dependent peoples' livelihoods are met. Due to remoteness of locality, it is difficult to ensure access to public services. Under such constraints, recent researches (e.g., Phelps et al. 2010, Sandbrook et al. 2010) have emphasized to integrate reducing emissions from deforestation and forest degradation (REDD+) into the CBFM schemes. Reducing deforestation and improving forest condition are being pushed as a measure of CBFM success by those developing REDD+ schemes (Lambrick et al. 2014). It also ensures the 3Es, i.e., effectiveness, efficiency, and equity and cobenefits for REDD+ projects (Agrawal and Angelsen 2009). The CBFM approach can deliver multiple outcomes—carbon storage, livelihoods benefits, and biodiversity conservation (Sandbrook et al. 2010; Bluffstone et al. 2013). It has been suggested that CBFM is a significant means of conserving carbon, particularly under conditions of community ownership of forests (Chhatre and Agrawal 2009). If forests are a significant source of greenhouse gases, and a large part of world's forests are governed under the ambit of CBFM, resulting in better forest governance (Agrawal and Angelsen, 2009; Skutsch et al. 2009), it would be useless to imagine mitigating climate change without explicitly addressing how to integrate CBFM into REDD+.

However, integrating CBFM into REDD+ schemes is not straight forward. The main challenge has been that people look at REDD+ from a large-scale point of view which involves substantial transaction costs. For small-scale forests, doing the carbon measurements and all other process, the transaction cost might be higher than what could be gained from additional forest carbon (Hajjar 2015). As this is the case, researchers emphasize on "non-carbon" values (such as local livelihoods, security of land tenure, biodiversity conservation, and good governance) of REDD+ schemes, and in such situation, REDD+ would be a potential win–win situation for the attainment of both carbon and non-carbon benefits (Vijge 2015). In a successful REDD+ project in India, the project is mainly focused on non-carbon benefits, involves both technical experts and local communities in monitoring, reporting, and verifying (MRV) design and execution, and relies on both fund-based finances and the sale of carbon credits (Vijge 2015). Plan Vivo (2012) considers this REDD+ project as a mechanism that simultaneously improves livelihoods, restores ecosystems, and reduces climate change by empowering communities "at the frontline of climate change." Sequestering carbon is presented as a means to achieve above objectives and is treated as a secondary objective (CFI 2006). Motivations for local project participants to be involved in the project included protection and restoration of forests, and improvement of livelihoods of present and future improvement of watersheds, reduction of soil erosion, capacity building among local communities, and carbon storage were not mentioned as a prime motivation to be involved in the project (Vijge 2015).

The studied CBFM schemes have benefited local communities through livelihood support and at the same time conserve local biodiversity, halt land degradation, and definitely sequester atmospheric carbon. The non-carbon values of forests are much important to communities than that of carbon values. In order to sustain the supply of these values, the CBFM schemes can be more benefited if these schemes are integrated into REDD+ projects. The communities involve with CBFM are capable enough and have long experience to work in the participatory forest governance. These attributes might be helpful to involve them in REDD+ project. The size of individual CBFM is usually small, and hence, all similar sites can be combined together to join in REDD+ projects.

7.5.2 Mutual Rotating Fund and the CBFM

The Arannayk Foundation (Bangladesh Tropical Forest Conservation Foundation) has been working with tropical forest conservation in Bangladesh for more than a decade and introduced several participatory conservation efforts through Mutual Rotating Savings and Loan Funds (MRSLF). The MRSLF has been introduced to generate alternative income opportunities for forest-dependent poor communities. These opportunities include home gardening, livestock rearing, vegetable farming,

aquaculture, and small businesses. The foundation through its partner non-government organizations organizes forest-dependent groups (FDGs) in project villages, and each FDG usually consists of 30 households. These NGOs also provided training to FDG leaders on the concepts, practices, and tools of organizational development and management including financial management. In each project village, the FDG established the MRSLF through members' monthly savings and grant from the project. Under Climate Resilient Participatory Afforestation and Reforestation Project, 200 FDG was organized and the MRSLF was stood about BDT 67.76 million of which BDT 8.16 million came from their monthly savings scheme and BDT 59.6 million from project grant (Arannayk Foundation 2016). The members of FDG get loan (BDT 5000 to 25,000) from this MRSLF for investment in alternative income generation activities. In two years' time, the interventions of this project component resulted in 20 % increase in average annual income of the beneficiaries and reduced their forest dependency by 21 % (Arannayk Foundation 2016).

This kind of fund management seems effective to generate alternative income sources of forest-dependent communities and also to enhance the managerial capacity of the local leaders. The sustainability of FDG after phasing out of project period is very important to sustainably manage the MRSLF. The local union council, the local forest department office, and the federation of FDG in each union council may liaise with FDG and jointly monitor the fund management activities. In CBFM sites, the application of MRSLF can be a win–win approach to improve the livelihoods of forest-dependent people and at the same time conservation of forest resources. There will be no hassle on any technical issues as local people are capable enough to manage a small fund with small group of people. Local people in Bangladesh are aware about the importance of small-scale credit program, and contribution from the development project to each FDG is also minimal (in case of MRSLF only BDT 300,000). Therefore, it could be an appropriate approach to help poor forest-dependent people so that they would sustainably manage the neighboring forest resources.

7.5.3 Corporate Agencies and the CBFM

The corporate agencies are now very much aware about principles and goals of sustainable development. In order to fulfill their social and environmental responsibilities, these agencies nowadays participate in various social development and environmental conservation programs. Our recent experience shows that in Malaysia, many such agencies including Sime Darby, the HSBC, and the Bridgestone Tyre Sales have been helping several CBFM initiatives through their financial contribution to plantations and community development activities. In Bangladesh, there are many national and international corporate agencies operating

their business. Although many of them have been contributing to social development through students' scholarship, initiatives can be taken to draw their attention on conservation of forest environment and community development. There should be no doubt that these agencies will be happy enough to participate in these types of programs. Along with social and environmental development, these agencies will also fulfill their mandate on climate change mitigation. The involvement of corporate agencies in CBFM could be a new dimension of collaboration in Bangladesh and it requires a strong initiative from forest department and concerned NGOs. The Arannayk Foundation with their vision of tropical forests conservation in Bangladesh can also take this advantage to invite corporate agencies in its mission.

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