

Forest and agrarian change in the Chittagong Hill Tracts region of Bangladesh

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Summary

This chapter examines forest and agricultural land-use changes in the Chittagong Hill Tracts (CHT) region of Bangladesh. The CHT region contains more than 40% of the total forest cover of the country. Although forest resources in the region have been historically important for the well-being of the local population and the national economy, their sustainable use and management remains challenging.

As part of the Agrarian Change Project led by CIFOR, we conducted a pilot study to examine land-use practices, livelihood patterns, resource tenure and ownership, institutional settings and conservation practices in three districts in the CHT region. We identified three land-use zones in this landscape for further research. The information was collected mainly through semi-structured interviews with key informants from government and NGOs, and with elected people's representatives. We also conducted FGDs with local community people and gathered participant observations. Gray literature (i.e. published government documents and annual statistical pocketbooks) and peer-reviewed articles and books on CHT and Bangladesh were reviewed.

6.1 Introduction

Bangladesh has 2.52 million ha of tropical forest, amounting to 10% of its total land (BFD 2015). More than two-thirds of its population live in rural areas and are directly and indirectly dependent on forests – from using forest resources as a direct source of food to using forest resources for primary energy and health care. Despite the linkages between rural livelihoods with forest and tree uses, deforestation has been a major threat to the protection of biodiversity and associated ecosystem goods and services.

An FAO (2010) study reported that approximately 2000 ha of forest cover per year was lost between 2000 and 2005. During the 19th century, approximately 50% of the area of natural forests in southeastern (hill forests) and central regions (sal forests) decreased.¹ Among the underlying causes were excessive collection of forest resources including NTFPs, encroachment of land for agriculture use and human settlement, and ineffective institutional measures for plantation and commercial harvesting causing massive degradation (Salam et al. 1999).

Bangladesh is one of the most densely populated countries in the world; there is increasing pressure on land, particularly in forest areas due to food production, building settlements and industries (Salam et al. 1999). Agriculture related activities cover 60% of total land use and provides major livelihoods to more than two-thirds of the rural population (Ghose et al. 2014). However, lower land availability per person, given geographical constraints and lack of effective cultivation practices, limits food production capacity. Although poverty has reduced in the last few decades, landownership still determines the level of food production and access to other natural resources. The average agricultural land size has declined to 0.68 ha; this is unlikely to sustain livelihoods in this sector.

Forest and agriculture land uses have an important role in the livelihoods of people living in the CHT region of Bangladesh (Miah et al. 2012). Historically, forest landscapes provided a wide range of local and regional benefits such as food, energy, timber, water, health and national revenue generation. However pressures from exploitation and degradation that commenced during the last century (Rasul 2007) and continue to the present have implications for sustaining livelihood benefits of forest dependent people in terms of direct and indirect provisioning services (Rasul 2009).

Agriculture makes a large contribution (80% of the food intake) to the annual food needs of households in the region (UNDP 2009). Shifting cultivation has played a vital role in the food system of traditional ethnical people. But this land-use practice has faced severe pressure from increasing population for food production, limited availability of land and market demands. During the last few decades, most of the agricultural system has experienced a decline in yield, degradation of the forest areas and a threat to food security. Agriculture has effectively intensified in order to maintain household food levels; it has transformed through use of a short fallow period for shifting agriculture, adopting cash crops, and fruit and tree management. However, sustainable land use to secure food stocks and reduce forest degradation is a challenge in this region.

¹ There are three types of forest in Bangladesh (hill and sal forest, and mangroves). Geographically, CHT has hill forests that are tropical evergreen and semi-evergreen.

6.1.1 Aim of the study

This scoping study aimed to explore forest and agrarian change processes in the CHT region of Bangladesh. Food production and conservation of forests are important to sustain many direct and indirect services for supporting rural livelihoods in CHT.

This study was conducted to:

- understand forest and agricultural land-use systems in CHT
- identify the trends and underlying causes of forest and agricultural land-use changes in the region
- identify a suitable landscape(s) with different land-use intensification for further research.

6.1.2 Methods

The study was conducted in five villages (Uluchari, Bagmara Headmanpara, Paglachara, Angadpara and Kamalchari)² in Rangamati, Bandarban and Khagrachari districts in CHT (Figure 6.1). The villages were selected after consultation and discussion with local government and NGO officials and local elected union³ chairman/members in the region following an introduction to the aims of the research and criteria for selecting three intensification zones in this landscape. The field visit was conducted from 3–24 May 2015. Three field assistants participated in the scoping survey and discussions. They organized FGDs with local people, guided the field trips and facilitated in translating the question and answers into local languages (Chakma, Tanchangya and Marma). The research comprised a combination of tools including semi-structured FGDs, key informant interviews and personal observation. The FGDs were mostly informally organized in the village centers, such as at the village shop or the house of the local headman and *karbari*.⁴ The research assistants were representatives of a local NGO (Tahzingdong) and staff of the traditional king's (*raja* or chief of each circle) office. They communicated with the local head of the village (i.e. headman) to invite participants.

In each FGD, 5–6 local participants attended and a total of 30 people participated. The participants were mostly (male) farmers and also included local elites, elderly people and women farmers. Each discussion continued for approximately 90–120 minutes. During the FGD, topics included local land-use types, agricultural farming practices and different crop production. The role of agricultural crop production in food and cash incomes of the villages was also documented. Questions about the major changes in their land uses or agriculture practices, the underlying causes, diverse effects on food productions and conservation were also raised. Participants shared their views on impacts on forest and tree cover in the region, access to forests and products, changes in forest types, and the impacts on their food security and diversity, and on other ecosystem services.

2 Uluchari falls in Farua union under Belaichari subdistrict in Rangamati district. Bagmara Headmanpara falls in Rajbila union under Bandarban subdistrict. Paglachara and Angadpara fall in Rowangchari union under Rowangchari subdistrict in Bandarban district. Only Kamalchari falls in Kamalchari union under Khagrachari district.

3 The lowest administrative unit in Bangladesh.

4 A headman is the head of a *mauza* (a *mauza* is a local revenue collection point covering a collection of villages). A *karbari* is the head of a village.

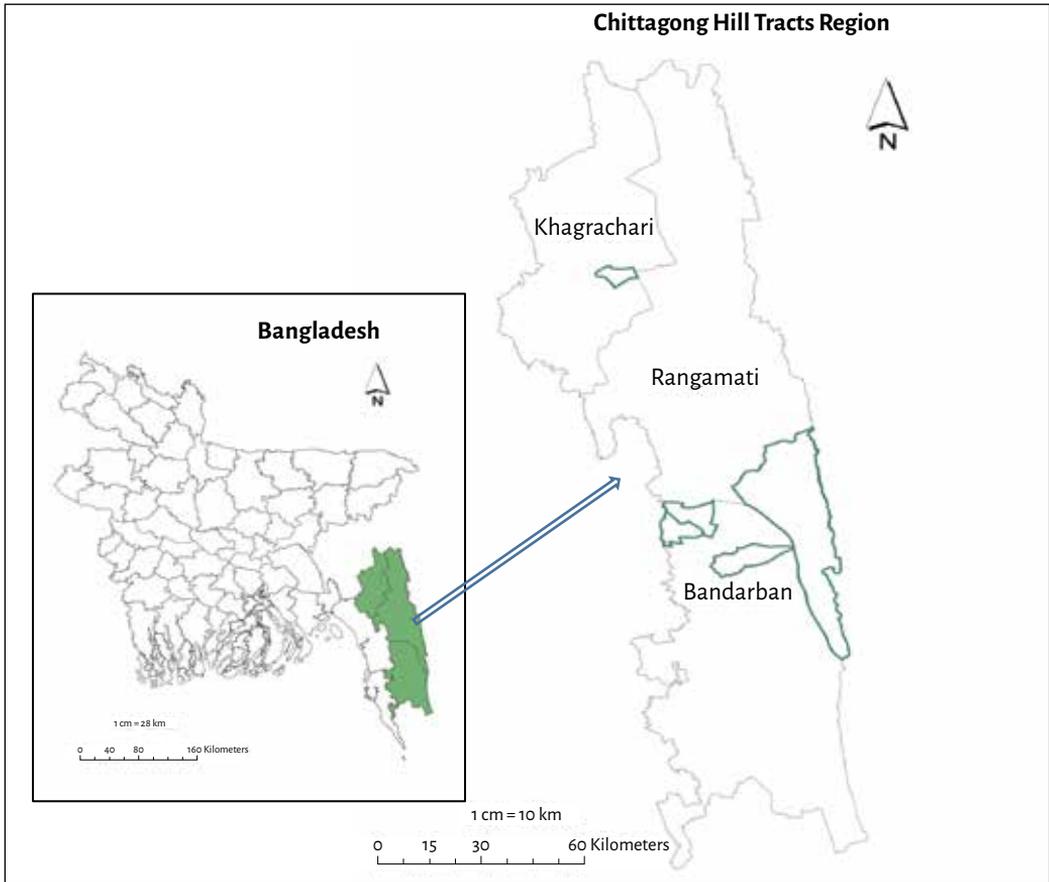


Figure 6.1 Map of the Chittagong Hill Tracts region, Bangladesh.

Note: The green colour boundary indicates the location of the five villages visited during the scoping study.

General observations were also recorded by undertaking transect walks along the village roads and farming lands, and two to three visits to the nearby markets in Belaichari and Rowangchari subdistricts of Rangamati and Bandarban districts to capture the daily livelihood activities of local communities. This assisted in observing informal social interactions of people within the locality. Visits to agricultural plots (i.e. shifting cultivation) were undertaken to observe the land preparation (i.e. clearing, burning, weeding, sowing etc.) and different farming activities (i.e. harvesting and processing of paddies). The use of different forest and tree products in households was observed, as well as the processes people used to collect and use the forest products. While observing different forest and tree-covered lands, notes were recorded on the direct and indirect contributions to ecosystem services.

The findings of the interviews and discussions were summarized. Information was also collected through reviewing government documents, websites, books and articles.

6.2 Brief description of Chittagong Hill Tracts region

The CHT region is a unique geographical and cultural landscape of Bangladesh. Located in the southeast of the country, it has three administrative districts: Rangamati, Bandarban and Khagrachari (Figure 6.1). The approximately 13,300 km² area of the region covers 8% of the total land area in the country (BBS 2014). The CHT region is bordered by Assam and Tripura states of India on the northeast, Arakan state of Myanmar to the southeast and Cox's Bazar district in the southwest. A brief description of the historical context and events, ethnic composition, population growth, migration patterns, tenure arrangement and institutional settings of the region is provided below.

6.2.1 Political history of Chittagong Hill Tracts

Historically, the social and institutional structure of CHT was unique in Bangladesh (Rasul 2007). Traditionally established customary rules of local ethnic communities were the only instrument to control natural resource management, collect taxes and implement any other social and cultural activities in most parts of the region (Khan et al. 2007). There were three traditional chiefdoms in CHT: Chakma *raja* (king of Chakma circle, a traditional administrative division in CHT), Bomang *raja* (king of Bomang circle) and Mong *raja* (king of Maung circle).

Until the beginning of the colonial period in 1757, the ethnic communities had absolute control over local resource management and major administrative activities (Rasul 2007). After 1757, external rulers gradually influenced administrative work. The East India Company expanded their rules and business in the Indian subcontinent including CHT. The British Government took over the control of India from the East India Company and expanded their tax collection in the region from 1857. As a result, the hills of the Chittagong district were classified as CHT, a separate subdivision in 1860 (Khan et al. 2012).

In 1900, the British Government introduced The Chittagong Hill Tracts Regulation of 1900 Act (or the CHT Manual 1900) (Rasul 2007). One of the main goals was to demarcate the boundaries of CHT, regulate the reserved forests and maintain traditional administration of the region with national administrative process. Until 1947, the region was a part of the Indian subcontinent. India became independent followed by a division into Pakistan and India in 1947 and CHT fell within the East Pakistan area.

During the Pakistan regime, in 1962 a dam on the Karnafuli River was constructed under the Kaptai Hydroelectric project to generate electricity. An artificial lake known as Kaptai Lake was eventually created that caused inundation of about 40% of the farming land and resulted in a loss of forest biodiversity (Khan et al. 2007). As a result, at least 100,000 people lost their land and livelihoods and many of them migrated within the region and outside into neighboring states of India (Rasul and Thapa 2006).

After Bangladesh became independent in 1971, there was a growing movement by local ethnic communities (under a group of activists called *Parbatya Chattagram Jana Samhati Samiti* (PCJSS)) demanding a sovereign state (Shelly 1992). From 1973, a state of insurgency was declared with armed conflict between the armed wing of PCJSS and the law enforcing agencies (mainly the Bangladesh military wing of CHT). This armed conflict continued until the mid-1990s. To end the violence and conflict, the Bangladesh Government signed a peace accord with PCJSS in 1997. Since the treaty, the incidence of violence has reduced and government agencies and NGOs have increased their development work in the region (Khan et al. 2007).

6.2.2 Ethnic composition

The people of CHT are diverse in terms of ethnicity, language, clothes, buildings and religion. Twelve ethnic groups live in the region and are known as Chakma, Marma, Tripura, Mrung, Tanchangya, Bawm, Chak, Pangkhua, Lushai, Khyang, Khumi and Rakhain (UNDP 2009). Chakma, Marma and Tripura comprise the largest proportion at 46%, 29% and 13% of the local ethnic population, respectively (Figure 6.2).

Apart from these traditional ethnic groups in the region, Bangalee (the main race in the country) comprise almost half of the population at present. Indigenous ethnic groups comprise 51% of the population. Chakma comprise the largest ethnic group and the Lushai is the smallest of the ethnic groups. The average household size in the region is 5.2, which is slightly higher than the national average of 4.8. Despite the local ethnic diversity, almost 57% of villages/settlements are comprised of a single ethnic or language group. More than one ethnic group is located in 20% of the villages. Only 16% of villages in the region are Bangalee dominated.

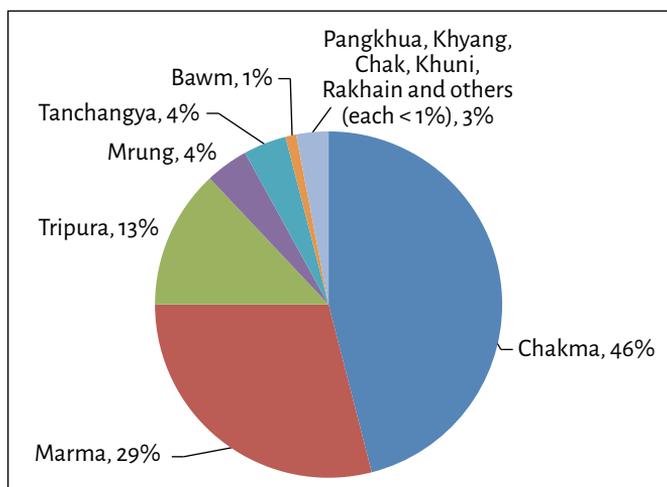


Figure 6.2 Proportion of local ethnic groups (not including Bangalee) in the population of Chittagong Hill Tracts.

Source: UNDP (2009)

6.2.3 Population growth and migration patterns

The CHT region has experienced a steady increase of population in the last few decades. The current population density is 87–230 persons per km² in the region (BBS 2014). According to the last population and housing census of 2011, the total population of CHT is 1.59 million while the total population of Bangladesh is 158 million (BBS 2015). Until 1951, the population in the region was 287,274 people, mostly comprised of local ethnic groups. Since the 1960s onwards there has been a rapid influx of lowland people into the region, which has been responsible for its population growth.

The Bangalee population in CHT has increased about five times from 26,000 in 1961 to 119,000 in 1981 (Khan et al. 2007; UNDP 2009). Most of the Bangalee population migrated into the region through different government settlement programs. Figures for the transmigrant population are not available for the region. Approximately 350,000–450,000 people migrated between 1979 and 1981 (Khan et al. 2012). As such, the number of newly settled people comprises up to 60% of the local population. The population data show that the total population of CHT was 974,445 in 1991, and increased to 1,342,740 in 2001. The recent census shows that the population is steadily increasing (Figure 6.3).

Apart from in-migration to CHT, there was migration of ethnic groups within and outside the region. Among the total 183,000 households in rural CHT, nearly 56,000 households have experienced at least one displacement since 1978 (UNDP 2009). About 13% of all CHT rural households had at least one household member who migrated from his/her village/settlement before the 1997 Chittagong Hill Tracts Peace Accord.

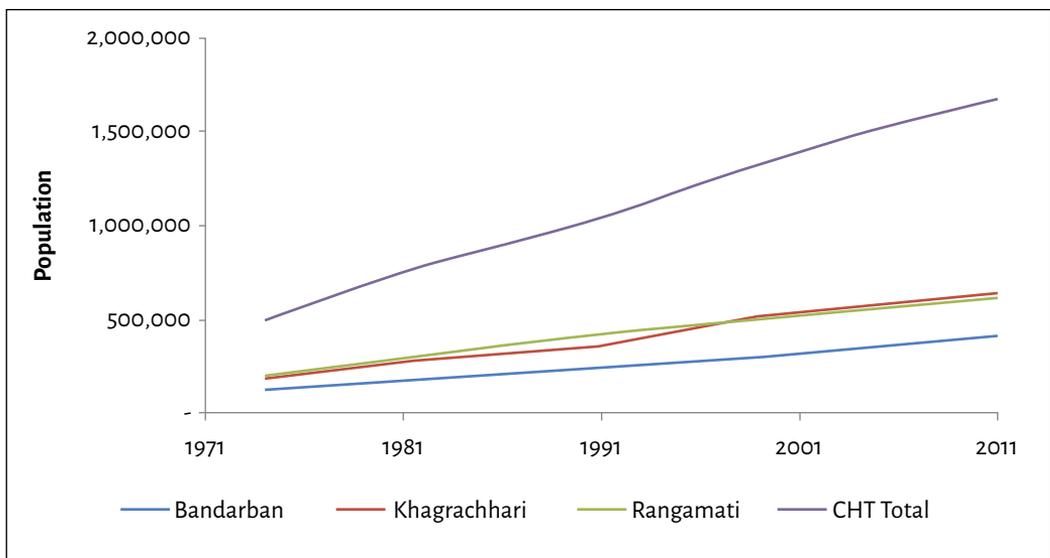


Figure 6.3 Trend in population growth in Chittagong Hill Tracts.

Source: GoB and FAO (2013)

More than one in five ethnic households experienced migration within CHT, to other regions and to other neighboring countries. Long-term security issues (i.e. the movement for constitutional rights on lands and regional autonomy) due to political unrest from 1976 until 1997 was one of the underlying reasons for in- and out-migration. Eviction from farm land and lack of adequate work opportunities were also reasons for out-migration.

6.2.4 Land tenure and ownership

The land tenure conditions and ownership system in CHT are different to that in the rest of the country (Roy 2012). Ownership patterns include the dual arrangement of the customary and formal administrative process for accessing lands. In most cases, the ownership of land and accessibility to forests and shifting cultivation land are based on complex arrangements (Islam et al. 2007). While customary rules guided access to the use of land in the region until 1950s, the gradual introduction of new administrative systems and changes in forest management practices has influenced the ownership patterns in the region since then (Rasul and Thapa 2006).

Historically, common property systems have been the traditional way of accessing land and deciding on ownership of settlement and cultivation areas in the villages in CHT (Rasul 2007). This comprises a *de facto* ownership type where local ethnic people enjoyed rights to use land and forest areas for subsistence livelihood activities. Based on customary rules, the local headman is responsible for distribution of cultivable lands. The local headman maintains a record of the land-use distribution but many also remain unrecorded. The absence of a legal framework in the last century mean that people seldom claimed their possession over land (UNDP 2009). People lived and cultivated a piece of land for a short period and then moved to other cultivable hills within the settlement or outside it. However in the customary system, a farmer can take ownership of post-harvested farming areas if he decides to cultivate trees and fruit plants there (Khan et al. 2012).

At present, there is an increasing legal or *de jure* arrangement for accessing land. However, only one-third of the total population in CHT has legal registered rights to land and this is higher among the Bangalee community than other local ethnic groups. Over 50% of the Chak community has legal ownership of lands (UNDP 2009). The total population who have access to land in terms of combined registered and customary ownership (recorded) is much higher than only those who are registered. Recorded customary ownership is higher among local ethnic groups than among Bangalee people. Taking into consideration all forms of ownership (legal, customary-recorded and unrecorded common property), more than 90% of the population has access to land (UNDP 2009).

Land tenure is unclear and ambiguous in the case of accessing agricultural cultivation and forest areas in CHT. Traditionally, people accessed forest areas for different forest product collection and shifting cultivation (i.e. subsistence farming) following customary rules. Many of these rights have reduced as government control on management of forests and adjacent land-use systems has increased. Although people have access to government forests in some cases, their secure tenure rights have not yet been properly addressed (Khan et al. 2012). Overlapping of resource jurisdiction areas between customary land and government reserves also creates complexities in the management of traditional common property (i.e. forests and shifting cultivation lands).

Forests cover one-third of the total land in CHT at present and are mostly government owned (Islam et al. 2007). Since the 1880s, over 394,300 ha of land classified as reserve forests and another 905,000 ha of shifting cultivation land have been unclassified state forests (Khan et al. 2012). During 1900–2000 there has been a gradual expansion of state ownership of different land uses including reserve forests covering more than 50% of total forest areas. This trend has impacted on the livelihoods of local ethnic people by limiting their accessibility to forests and traditional ownership of land (GoB and FAO 2013). At present, a limited number of local people have accessed lands with secure title for private forest and agricultural use.

A secure tenure arrangement is appropriate in CHT when there are questions of improving food security and sustaining forest and land uses (Bala et al. 2012). Tenure rights on settlement and available farming lands are a sociopolitical issue in the region (Roy 2012). Withdrawal of customary tenure rights of local ethnic people occurred during the construction of the Kaptai Reservoir in the 1960s, causing a loss of food production areas. Tenure arrangements have been further complicated with the settlement of lowland Bangalee people since the 1980s; they have received formal land title and leases for plantations (Rasul 2007).

Ethnic communities are less familiar with formal land title processes, so their ownership remains unspecified or not adequately documented in their rights to farming land (Islam et al. 2007). Displaced local ethnic people including traditional shifting cultivators were settled through a government monoculture plantation or horticulture livelihood development program without sufficient institutional support for proper land titles (Khan and Khisa 1999). Insecure tenure of local ethnic communities is still the case for many who follow customary rules and they may be negatively affected if not adequately involved with forest management and land improvement practices in the region.

6.2.5 Institutional setting

Bangladesh follows formal administrative systems at national and local levels to plan, regulate and implement overall development work. A number of government agencies regulate the local administration, infrastructure development, health, education, agriculture/forest/fisheries/livestock related extension and management services. A traditional institutional structure headed by kings⁵ has perpetuated in the region in parallel with the government administrative system. Here we discuss the institutional arrangement in relation to managing forests and land resources in CHT through a review of mostly unpublished documents.

Formal institutions

There is a range of organizations that have responsibility for land and forest management in CHT of Bangladesh (Table 6.1).

⁵ The entire CHT region has three taxation circles in traditional rules. Each circle has a king or chief (also known as a *raja*). Three chiefs/kings represent Chakma, Bomang and Mong circles respectively. The king of each circle serves different ethnic groups located within their jurisdiction irrespective of any specificity.

Table 6.1 Key institutions related to land and forest management in the Chittagong Hill Tracts of Bangladesh.

Institutions	Key roles	Legislation implemented
Ministry of Chittagong Hill Tracts Affairs	Coordinating agency between national and regional and district councils, Chittagong Hill Tracts Development Board on local resource management programs	Established as of the Peace Accord, 1997
Local section of national Forest Department of Bangladesh	<ul style="list-style-type: none"> • Decision making for the management of natural and plantation forests including control of agriculture practices • Declaration of any lands to be reserved as protected forest • Protection of illegal collection and marketing of forest products including timber and animals • Collection of revenue from forest products 	Bangladesh Forest Act, 1927
District administration headed by the deputy commissioner of local government	Control of unclassed state forests, decisions on land lease for private ownership, settlement and plantation or farming activities	CHT Manual 1900 Chittagong Hill Tracts Land Acquisition Regulation, 1958
The Chittagong Hill Tracts Regional Council headed by an elected representative from local ethnic groups	<ul style="list-style-type: none"> • Representing the interests of 13 ethnic groups for land rights while undertaking measures toward land rights development • Coordination with forest department and district administration on land allocations • Technical support to government on land management related programs 	<ul style="list-style-type: none"> • CHT Manual 1900 • The Chittagong Hill Tracts Regional Council Act, 1998 • The Hill Districts Councils Act, 1989
District council in each district	<ul style="list-style-type: none"> • Land resource improvement programs • Prevention of any further settlement • Formulate and review projects related forest and agriculture land uses 	The Hill Districts Councils Act, 1989
Chittagong Hill Tracts Development Board	Implementation of development projects focused on upland settlement through agroforestry, fisheries and livestock related programs	
Circle chief office (traditional king)	<ul style="list-style-type: none"> • Collection of tax from agriculture land farming as a royalty for traditional administration and government treasures • Supporting government for maintaining appropriate land use • Appointment of headman and <i>karbari</i> for appropriate tax collection, land allocation and taking preventive measures against intentional fires and illicit felling of trees in the customary forests 	CHT Manual 1900

Source: Islam et al. (2007)

Forest resource management is the key role of the Bangladesh Forest Department, which is under the Ministry of Environment and Forests. It is responsible for at least one-third of the land in the region and is an important stakeholder in natural resource management (Roy 2012). The process in planning, decision-making and implementing any plantations and protection activities for forest areas (i.e. reserves, national park, wildlife sanctuary etc.) of the Bangladesh Forest Department is formal. To a large extent, community involvement in forestland management is limited except in a few upland settlement programs for plantation activities.

The Department of Agriculture Extension (Figure 6.4) have a role in building advanced skills and introducing improved farming technology to rural households. However, their institutional capacity and size are inadequate, and they are generally unavailable and inaccessible to remote households in the region (GoB and FAO 2013).

The district administration headed by the deputy commissioner (i.e. head of the local administration in each district) is another agency that has certain power and institutional arrangement for control of public lands in Bangladesh. This is also the case in CHT where the agency provides an essential role in permitting access to land for local ethnic, displaced and poor people. But the deputy commissioner has special power (in the CHT Manual 1900) to follow the traditional structure of local ethnic people in landownership distribution. As noted above, landownership remains a complicated issue. This is particularly critical in areas of “unclassed state forest” management (Islam et al. 2007). Most of this type of forestland was degraded due to shifting cultivation or commercial plantation programs during the 1960s to 1980s. The district administration controls this land for certain purposes, mainly farming, settlement and plantation programs.⁶

The Ministry of Chittagong Hill Tracts Affairs was formed in 1998 to conduct and monitor the activities from a national level. Appointed by the Prime Minister of Bangladesh, a minister is selected from the region to represent the local population. The Ministry guides the overall development plan for the region and undertakes the responsibility for operation of the regional council, district council, Chittagong Hill Tracts Development Board (CHTDB), *upazila* (subdistrict) *parishad* (council or assembly),⁷ *union parishad*⁸ and traditional administrative circles of the region. These institutionalized agencies work independently and are guided under district and *upazila* administration in land-related issues (Khan et al. 2012). There are also a few autonomous government agencies such as the Chittagong Hill Tracts Regional Council, Hill district councils and CHTDB working in the region (Table 6.1; Figure 6.4).

The CHTDB, established in 1976, operates as a regional autonomous agency (Khan and Mentel 2007). The CHTDB covers the development of agriculture, infrastructure, water, education sectors and other social welfare related works. It also implemented a

6 This department also controls line agencies such as *upazila* administration and land offices for implementing any land survey and settlement programs.

7 *Upazila parishad* have the key roles to plan, coordinate and monitor the activities of government agencies.

8 *Union parishad* are local councils of elected chairman and members of villages in Bangladesh.

resettlement program that supported the relocation of poor people from the Bangalee community into the region to improve their economic wellbeing. The CHTDB also undertook a resettlement program in the 1980s for shifting cultivators who were local ethnic people. However, both the agency and local ethnic people were disappointed with this resettlement program and its influence on land rights issues (Islam et al. 2007).

Under the Peace Accord of 1997, the Chittagong Hill Tracts Regional Council aimed to supervise and coordinate activities of local councils, government agencies and customary institutions at district and subdistrict levels (Islam et al. 2007). Any development activity in the region requires approval or consent from the agency before implementation. It coordinates law-related issues, customary rules, activities of NGOs and the necessary steps for disaster management and relief. The chairman represents all the ethnic people in three districts. However, the overall institutional and financial capacity of the regional council is considered insufficient to date (Islam et al. 2007).

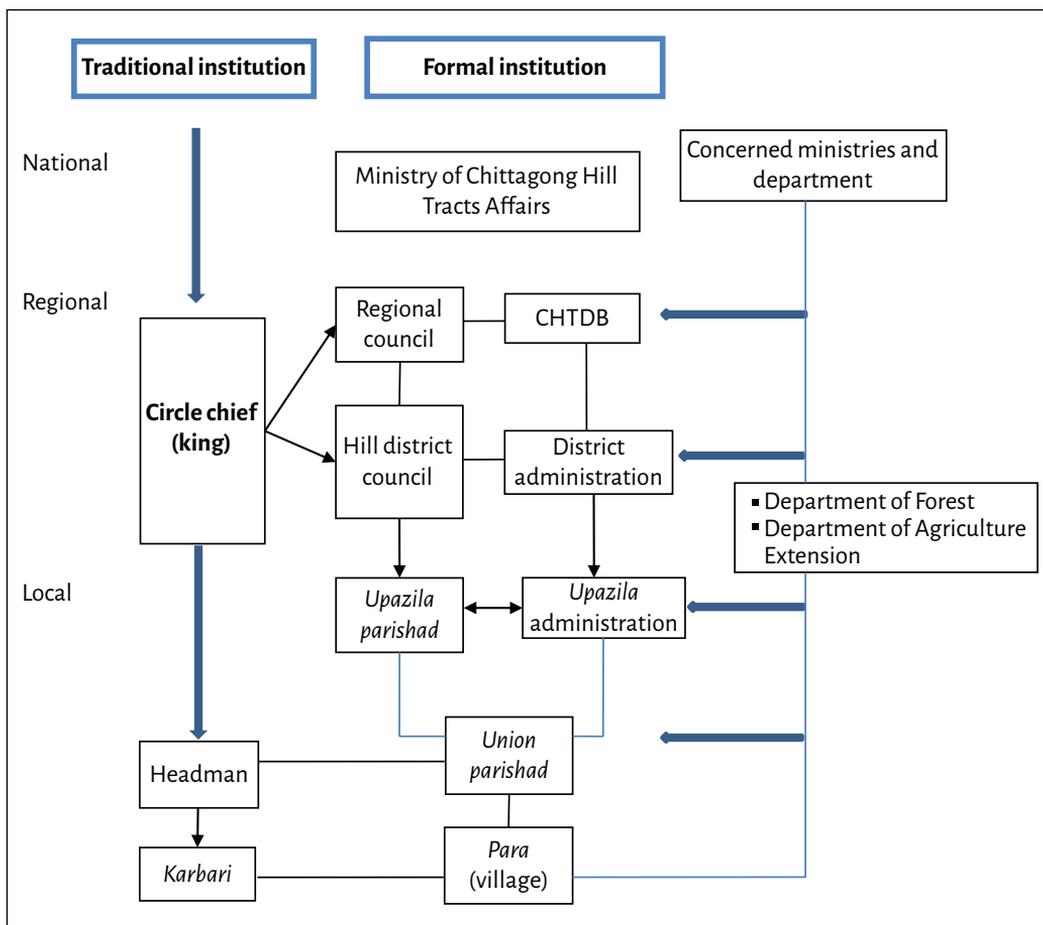


Figure 6.4 Institutional framework related to forest and land management in the Chittagong Hill Tracts region of Bangladesh.

Source: Data from GoB and FAO (2013)

In each district, a Hill district council plays a vital role in planning, financing and implementing natural resource management activities. The district council develops programs based on local priorities (e.g. improved agriculture practices), gets approval from the Ministry of Chittagong Hill Tracts Affairs and implements the programs through government departments. The district council also acts as focal agency for coordinating between government departments (Khan and Mantel 2007). The relationship between these national, regional and local institutions is shown in Figure 6.4.

Traditional institutions

Forest and land management are the major tasks of the traditional (informal) institutions in the CHT region (Figure 6.4). The CHT region is divided into three taxation circles. Each circle has a king who determines the revenue and rules for the respective circle. There are boundaries or small units within each circle known as *mauza*⁹ for collection of revenues. The *mauza* controls land distribution among the local ethnic people for yearly farming activities. A headman in each *mauza* controls a number of villages and collects revenue for the chief and government and supports villager access to legal documents for permanent ownership. A *karbari* from each village assists the headman in collecting the revenue (Islam et al. 2007).

This circle structure is different from the formal boundaries of the government administration but it corresponds to the district government administration. The CHT Manual 1900 ensures the formal functions of the circles in the region. The distribution of total collected revenue from each *mauza* is 42% for the king, 37% for the headman and 21% for the government.

Common forestland is traditionally maintained in each *mauza* depending on the availability of this resource. This is however recognized as village common forests and has received greater environmental and economic potential in the recent decades for this region. Each household head of the community is traditionally a member of the forest commons. Local people follow a set of informal rules for annual harvesting, collection of timber and NTFPs, clearing and burning activities (Misbahuzzaman and Smith-Hall 2015).

6.3 Major economic activities in Chittagong Hill Tracts

The economy of CHT is largely based on the forest, agriculture, fishery and livestock sectors. Forests contribute a significant portion of the economy (46%) at local and national levels, followed by crop/fruit production in the region (Khan et al. 2007). Historically, traditional shifting cultivation practices contributed to local livelihoods through the production of locally available foods and sources of subsistence economic activities. In the last two decades, the intensity of shifting cultivation has decreased or been modified with cropping patterns, mostly involving planting fruits and trees

⁹ Revenue collection points.

that have increased economic benefits. Plough-based agriculture for intensive cultivation in plain lands¹⁰ has increased in recent years. However, lack of suitable lands, irrigation sources and adequate extension services are still major constraints to improving the economic capacity of rural households. Drawing on reviews of existing studies (UNDP 2009; Kar and Jacobson 2012; Miah et al. 2012; Rahman et al. 2014; Misbahuzzaman and Smith-Hall 2015) and the results of the scoping study, the key economic activities or sources of household food and incomes in CHT are discussed.

6.3.1 Agriculture

The majority of rural households in CHT are dependent on agriculture related activities for producing food and income. Over 50% of the annual net income of all CHT households comes from different agriculture related sources (Figure 6.5; UNDP 2009). Food and cash incomes are generated by at least one agricultural related activity. Agricultural activities include ploughing lands, shifting cultivation, paid wage labor, livestock and poultry rearing, trees/nurseries, fruit gardening, fishing and making agriculture implements. The share of agriculture related annual income is higher in local ethnic households than in the Bangalees (63% vs. 49%) (UNDP 2009). Among the ethnic groups, the Khumi, Marma, Mro and Bawm people generate more than 67% of their net annual household income from agriculture related activities (UNDP 2009).

More than 35 different types of crops are cultivated in CHT annually. Agriculture crops including fruits and trees provide both subsistence uses and cash incomes for local ethnic groups. But the main cultivated crops are limited to seven including rice paddy, turmeric, ginger and banana. Cotton and sesame were once valuable cash crops but have gradually declined in recent years due to a decline in productivity. Different fruit species (i.e. banana, jackfruit, mango and litchi) have gradually replaced shifting cultivation crops due to increasing demand for cash incomes

The CHT region is one of the highest fruit production regions in Bangladesh (BBS 2015). Banana is a commonly produced horticulture crop in the region that is mostly cultivated in shifting cultivation areas with other crops for cash incomes that people harvest during fallow periods. More than 25% of households produce banana in their annual farming plots and home gardens (Khan et al. 2012). The annual yield of banana is about 88,000 tons, which is considerably higher than other fruits (BBS 2011). However, pineapple, jackfruit and papaya production also contribute significantly to the average household economy. There are also increasing levels of pineapple production as potential source of cash income, particularly in the last two decades.

10 Bangladesh forms the largest delta in the world and a large part of its landmass is plains inundated with rivers and tributaries. Small plain lands in valley bottoms, river banks and lower slopes in CHT only retain water during monsoon.

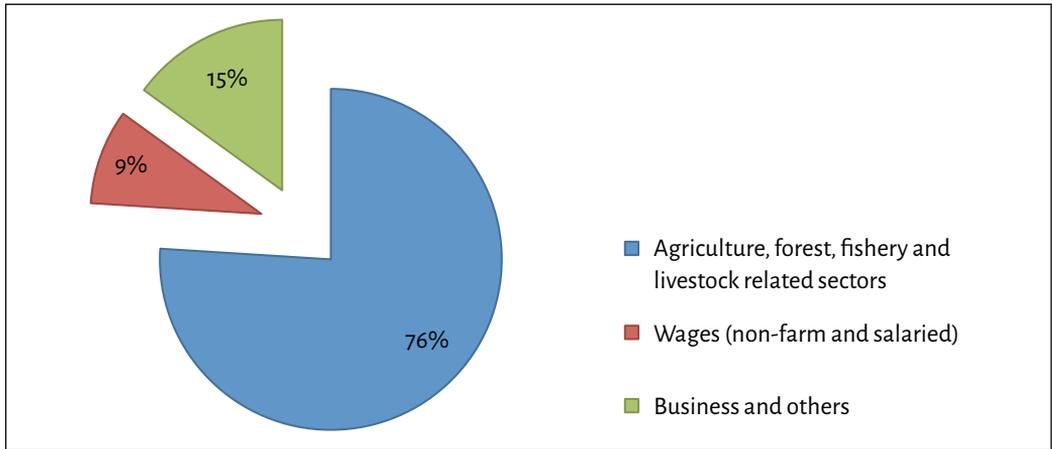


Figure 6.5 Different economic activities in Chittagong Hill Tracts.

Source: UNDP (2009)



Fruit farmers/sellers in Rangamati town (left) and farmers harvesting rice at Rangamati (right). (Ronju Ahammad/Charles Darwin University)



Bamboo rafting for water transportation in remote areas of Rangamati (left) and timber stored in a water vessel for transportation at Rangamati (right). (Ronju Ahammad/Charles Darwin University)

6.3.2 Forestry

Household fuelwood, food, medicines, shelter building materials and agricultural implements are common uses of forest resources in Bangladesh. Forest and trees provide direct and indirect economic benefits to local communities in CHT, as well as to the national economy.¹¹ Timber, bamboo, rattan, fuelwood, fruits and different types of grasses are the major sources of forest-based annual income. However, the number of people dependent on forest-based economic activities is difficult to estimate due to a lack of available studies for the region and across the nation.

In CHT, more than 60% of forest products including NTFPs are used at the household level and the remaining 40% are sold at local markets to generate cash income (Kar and Jacobson 2012; Misbahuzzaman and Smith-Hall 2015). At present timber is largely collected from planted forests. Natural forests still provide the largest stocks of bamboo, which are a potential source of forest-based economic activities in the region. However, the availability and sustainability of bamboo is yet to be clearly estimated.

NTFPs play a vital role in the traditional culture and life supporting functions of ethnic communities in the CHT region, as well as in the rest of Bangladesh (Mukul 2010; Miah et al. 2012). Although often regarded as small-scale, forest-based artisan activities (i.e. manufacturing different handicrafts) are important sources of informal employment. However, a lack of formal economic valuations of NTFPs may often undermine the appropriate numbers of people's dependency and their potential benefits to regional and national economies. For example, bamboo- and cane-made products (i.e. different handicrafts) and raw materials are in demand in the building construction industry and in nearby urban markets and cities, contributing important incomes to those manufacturing and trading them.

Among the NTFPs, bamboo is the most commonly used for making baskets, collecting and storing food grains and fencing around farming plots. People manage and collect at least four different bamboo species for household subsistence use and commercial purposes. The available information indicates that poor households are engaged in different steps of collection, processing and marketing of NTFPs and have relatively higher dependency on receiving annual income from forest-based economic activities (Kar and Jacobson 2012; Misbahuzzaman and Smith-Hall 2015).

6.3.3 Other economic activities

Bangladesh, as a riverine country, has large economic opportunities in small-scale fishing activities in almost parts of the country. Rivers, seasonally flooded lands and lakes are the main protein source for many people in the region. But the quantity of fish catches in rivers and flood lands have declined due to loss of natural habitats or degradation of watersheds in the last few decades (Khan et al. 2007). Only Kaptai Lake still provides major fish protein sources. The annual fish catch in the lake is 7336 tons per annum, which meets the local demand for consumption and a small

¹¹ Karnafuly Paper Mill, the largest paper mill in the country, is located in CHT and annually uses millions of tons of bamboo as raw material for paper production. Bangladesh Forest Industries Development Corporation operates a number of wood processing units to produce the major wooden products and generate national revenue.

commercial supply to markets in the nearest Chittagong city (BBS 2011). More than 5000 people are registered to fish in the lake. There are more than 35 fish species that are commercially important in Bangladesh. Though fish capture in the lake has increased, the sustainability of production and ongoing contribution to the regional economy could be problematic in the future due to overcapacity (Khan et al. 2012).

Livestock (mainly cows, goats and pigs) and poultry rearing contribute to household food supplies and small amounts of cash income. The sector also contributes about 5% to regional annual products (Khan et al. 2007). The average size of livestock used for subsistence in a household is slightly higher in CHT (4–12 animals/household) than the national average (2–8 animals/household) (BBS 2011).

6.4 Land-use practices in Chittagong Hill Tracts

The CHT region is different in terms of physical, geomorphic and soil characteristics to the rest of Bangladesh. The main land types are high and medium hills and there is a small area of lowland valleys and plain lands (Khan et al. 2007). The hills range between 150 and 500 masl. Forests including timber/fruit tree farming and shifting cultivation are the major land cover on the hills. Paddy cultivation is largely prevalent in the valley parts or the plain land areas of the region. Hills cover more than 85% of the land types with medium to steep slopes, so conventional agriculture is limited and instead managed for shifting cultivation or forest (Islam et al. 2007). Agroforestry practices with intensive fruit cultivation have also increased as another land-use practice. Here we explain forest and agriculture land-use practices in CHT. Most of the information is sourced from literature and key informant interviews during the scoping study.

6.4.1 Forestlands

Forested areas in CHT make up almost 43% of total forestlands in Bangladesh (BFD 2015). In terms of forest types, natural forests and plantation forests cover more than 70% of land areas in all three districts. The total forest area managed under the Bangladesh Forest Department in CHT is 483,000 ha, with 86,000 ha designated as plantation land (BBS 2015). The major plant species in the region are tropical wet evergreen/semi-evergreen and deciduous, and are classified as ‘hill forests.’ Among the plantation covers, teak (*Tectona grandis*) is the dominant type of plant in both government and private forestlands.

During the last century, commercial plantations with largely teak (*Tectona grandis*) plants increased in the region. Teak was primarily introduced as an exotic species in small patches of Kaptai National Park around 1920. One of the reasons was that the region had a major push for the harvesting of valuable forest timbers during British regimes. This was one of the reasons that commercial plantations preceded at the expense of natural forest coverage. Throughout the 19th century, planted forests replaced a large portion of natural forests. Along with these, commercial plantations with fast growing species, such as *gamar*, used for raw materials in paper and pulp making industries also expanded. The CHT region is a large source of plant-based industries managed under the Bangladesh Forest Industries Development Corporation.



Naturally grown bamboo forests in Bandarban. (Ronju Ahammad/Charles Darwin University)



Monoculture plantation of teak (*Tectona grandis*) in Rangamati. (Ronju Ahammad/Charles Darwin University)

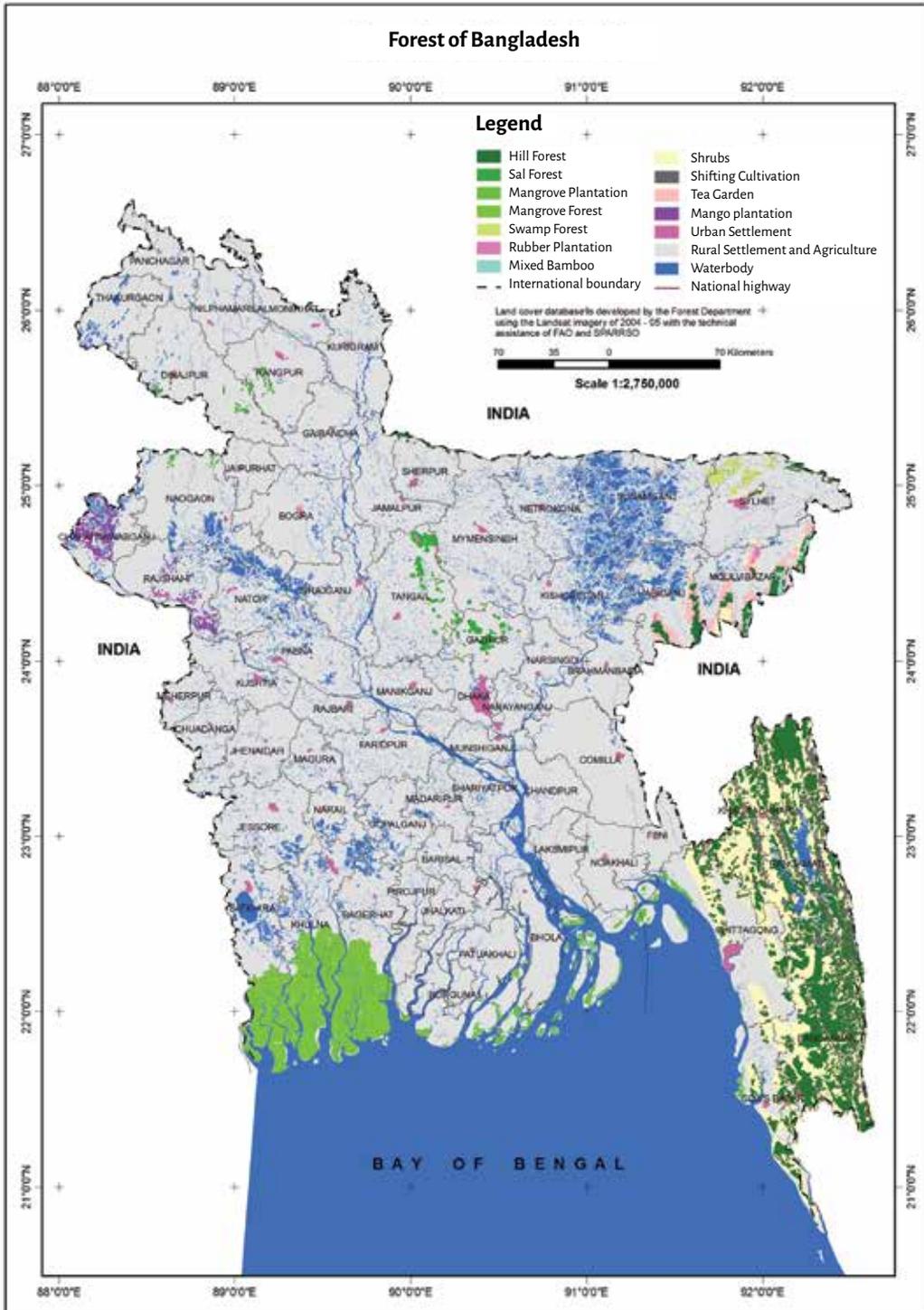


Figure 6.6 Forest cover map of Bangladesh and encircled forest areas in Chittagong Hill Tracts.

Source: BFD (2015)

Forestry and Engineering International Ltd, a Canadian consulting company, reported that more than 70% of land in the CHT region is suitable for plantation-based land use after a land-use survey in CHT in 1966 (Rasul and Thapa 2006). Government policy also supported the undertaking of large-scale plantation programs. As a result, plantation areas increased throughout the 1980s and 1990s. At present, plantations with teak cover the largest tract of the forests in government reserve areas, as well as private lands. Although timber harvesting from government forests has been banned since the 1980s in Bangladesh, the region still supplies a significant amount of valuable timber to meet the large demand at the regional and national level.

Historically, local ethnic communities depend on timber for day-to-day traditional uses such as fuelwood, making seasonal agricultural implements (i.e. baskets for crop harvesting and storing and constructing shelters in the village). For example, 50% of the raw materials used in building permanent or temporary shelters are timber or NTFPs. Commercial approaches to increasing timber plantations on hilly lands or home gardens is a relatively new concept and has been popular since the 1990s. In many villages in the CHT region, agricultural lands have been gradually converted with monoplantations, mainly with teak or *gamar* (Khan et al. 2012).

There is no record of the amount of privately owned land that has been converted for commercial timber uses, but generally these types of smallholder plantation areas range from 0.4–4 ha. The conversion of agricultural lands into timber plots is an increasing trend among large landholding families. Although customary ownership of the region dictates the distribution of farming lands for food production among local ethnic communities, poor households are yet to access this timber-based economy because of insecure tenure. The expansion of timber plantation areas might have economic value to some extent for those with secure ownership. But these replacements will not benefit subsistence communities in enhancing their food production due to decline in their access to productive lands or further threats to soil erosion (Khan and Mantel 2007).

6.4.2 Shifting cultivation

Shifting cultivation is a traditional land-use practice of ethnic populations in the region. Known as ‘slash and burn agriculture’ and referred to locally as ‘*Jhum* cultivation’, it is a common land-use type in CHT. At present, 16% of land is cultivated with this traditional system each year (Bala et al. 2012). Following a certain fallow cycle (3–8 years), farmers cultivate a plot of hill lands in different years. Locally available paddy varieties, ginger, turmeric, maize, sweet potato, other vegetables and banana are the most common crops in this system.

For many families, the shifting cultivation system is a significant source of locally accessible food for largely subsistence use and for a small amount of cash income throughout the year. The main feature of this land use is a combination of diverse crops for cultivation in one season (March–May) and harvesting gradually to secure food for the rest of month (August–December) (Table 6.2). Traditional and local knowledge held by generations of shifting cultivation farmers have contributed to this long-standing land-use practice in the region.

The extent of shifting cultivation agriculture is higher in Rangmati and Bandarban districts than in Khagrachari district (GoB and FAO 2013). Hilly lands cover much more area in the

former two districts than in Khagrachari. The size of shifting cultivation practices range from 0.5–3 ha in a family. The availability of farming lands and land suitability often determines the areas to be undertaken for annual cultivation. At present, shifting cultivation activities also comprise the planting of fruit species (e.g. pineapple, banana, jackfruit and mango). Traditional forms of shifting cultivation were based on only annual crops and retaining trees largely available in remote areas. Intensive forms of agriculture (i.e. mix of fruit trees and teak plantations) are now increasing in areas closest to markets and roads (Thapa and Rasul 2005).

Table 6.2 Major seasonal land-use practices in Chittagong Hill Tracts.

Activities	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Agriculture (shifting cultivation)				S	S			H	H	H	H	H
Agriculture (plain land plough cultivation)	S	H	H	H			S	S			H	H
Fruit collection				H	H	H	H	H	H			
Fuelwood collection	+	+	+	+	+	+	-	-	-	-	+	+
Collection of NTFPs (mainly bamboo)	+	+	+	+	+	-	-	-	-	+	+	+
Wage labor	-	+	+	+	+	+	-	-	-	-	-	-

Note: H = harvesting; S = land preparation and sowing; + = higher; - = lower.



Family members sowing seeds in a shifting cultivation plot in Rangamati district (left) and weeding management after paddy cultivation in Bandarban district (right). (Ronju Ahammad/Charles Darwin University)

6.4.3 Plain land plough agriculture

Ploughing agriculture is the most common type of farming in the plain lands of Bangladesh. The CHT region has much less area of plain lands and ploughing practices. Traditional practices by ethnic people involve digging soil with spades for cultivation instead of ploughing lands in their shifting plot. Ploughing was introduced by a small number of the lowland Bangalee migrants during the 1870s (Islam et al. 2007). With higher amounts of food production, plough cultivation expanded in all plain lands of the region and ethnic people since that time. Ploughing agriculture is only prevalent in valleys, riverbanks and lower slopes of the region.

The total cropped area under plough cultivation is much less in CHT compared to the other plain land regions of Bangladesh. Valleys and floodplains suitable for plough agriculture cover only 3.2% (270,812 ha) of the total land in the region. At present, less than one-fifth of these lands can be cultivated through ploughing for producing rain fed and irrigated agricultural crops (GoB and FAO 2013). The size of plain land declined in the region due to submersion of the cultivable lands after establishment of a hydroelectric dam resulting in approximately 21,850 ha of plain lands (which covered 40% of the best productive lands) being inundated (Olarieta et al. 2007).

Rice paddy, tobacco, sugarcane, maize, groundnuts, beans, different vegetables and fruit species are cultivated with the plough technology in the plain lands. The cropping intensity is still lower and often a single season farming is maintained for intensive and monoculture crop cultivation. Though there are increasing amounts of crop production in the plain lands in recent years, the overall productivity of this farming system is still lower compared to other areas of Bangladesh. However, plough cultivation provides opportunities for increasing cash crop cultivation with sugarcane, maize, tobacco, vegetables and rice.

6.4.4 Alternative land-use practice

In the last few decades, alternative land uses with horticulture (orchards) with or without timber trees have increased in CHT. Bala et al. (2012) point out that horticulture covers 28% of the land. Most of this land use are spatially distributed in the form of a patch of monoculture fruit plant (i.e. mango, pineapple) or mixed with different annual crops and trees. The average size of the horticultural plots vary from 0.2–0.4 ha.

Maintaining natural or cultivated trees alongside agricultural croplands is a common land-use practice in Bangladesh. Often this is characterized by planting trees in the vicinity of shelters or between shelters and agricultural land in rural areas. These agroforestry systems provide food, timber, NTFPs and fuelwood (Rahman et al. 2014). This type of crop and tree combination is also widespread in different forms across the region.

In traditional shifting cultivation, farmers usually retain a number of trees or fruit species for restoring soil fertility, improving biodiversity and harvesting of foods in successive years. However average tree size and numbers have decreased in this shifting cultivation practice to some extent due to short fallow periods and over-felling. Many studies have identified this type of land use as less suitable for enhancing food production in the CHT region. Modification of land uses with multi-strata agroforestry system, consisting of a combination of trees, fruit plants and crops is an intensive land use for increasing food production and restoring soil nutrients.



Trees and paddy land—a common agroforestry system (left), and fruit- and tree-based intensive agroforestry system (right) in Khagrachari. (Ronju Ahammad/Charles Darwin University)

6.5 Land-use changes in the Chittagong Hill Tracts region

The degradation of forest resources puts food production and biodiversity conservation at risk in CHT. Historically, shifting cultivation practices caused a loss in forest area and increased soil erosion. Over-harvesting of forest products during the colonial period, lack of effective national forest policy for the region and development practices at local level have triggered further deforestation. During the 1960s to the 1980s, population growth and mismatch of local development interventions followed by the construction of a large hydroelectricity dam further exacerbated land-use changes in CHT. In this section, we discuss key trends, the current state of land-use change, and their implications for food security and conservation. Most findings in the following section are sourced from literature and personal discussions with institutional interview respondents.

6.5.1 Agricultural land-use changes

Shifting cultivation is a major agricultural land use for local food production in the region although it has undergone changes in terms of fallow period, cropping patterns and productivity. Traditionally it was a more extensive land-use type for production and diverse annual foods in this forest landscape. Until the middle of the last century, traditional people maintained a 10–12 year fallow period for this land use that was effective for the enrichment of forest vegetation and essential soil nutrients in lands.

Studies have indicated that the land-use system changed through the decline of the fallow period (3–4 years) to maximize annual food production given the shortage of land (Rahman et al. 2012). Again, farmers previously cultivated a much larger number of crop varieties (> 35 different annual crops) in their traditional practices with minimal inputs. At present, they only cultivate 3–4 annual crops and perennial fruit varieties for subsistence needs and for increasing their cash income.

Trends in these changes were observed during the scoping study. Cultivation of cash crops, fruits and/or monoculture tree plantations has increased in recent decades in CHT. People either cultivate a single crop or a mixture of crops (two to three types) and/or fruit trees

using large quantities of fertilizers and pesticides. The annual crop cover includes spices (turmeric and ginger) with rice paddy, cotton, maize, vegetables, beans and seasonal fruits (mainly lemon, mango, jackfruit and cashew apple). Compositions of these cash crops vary in terms of land type (hills or plains), ownership, land size and access to roads/markets. Evidently people cultivate only two to three types of agricultural crop or fruit plants in the traditional shifting cultivation system. Monoculture crop cultivation increased on a seasonal basis and was dominated by rice paddy, tobacco and seasonal vegetables in the plain lands (Table 6.3).

Table 6.3 Historical trends of forest and agriculture land-use changes, their causes and effects in Chittagong Hill Tracts.

Land-use types	Key changes	Underlying causes	Effects on food security and ecosystems
<p><u>Agriculture land use until 1970s:</u></p> <ul style="list-style-type: none"> • Shifting cultivation with a long fallow period (> 10 years) • Low level of agriculture input systems and subsistence oriented • Much more forest vegetation • Diversity of annual crops 	<p><u>After 1970s and to date:</u></p> <ul style="list-style-type: none"> • Decrease of fallow period in shifting cultivation • Intensive cultivation of lands with agriculture inputs (i.e. fertilizer, water and labor) • Increased cash crop production (mainly horticulture, lower yields of annual crops e.g. ginger, turmeric, paddy, tobacco, maize etc.) • Increased use of plough agriculture for cultivation of cash crops 	<ul style="list-style-type: none"> • Limited land availability and accessibility • Lower productivity of land • Population growth • Loss of forest vegetation and soil nutrients 	<p><u>Positive:</u></p> <ul style="list-style-type: none"> • Increased food quantity of few crop varieties and cash incomes • Limited forest area or land required for cultivation <p><u>Negative:</u></p> <ul style="list-style-type: none"> • Less numbers of food crops cultivated • Loss of locally available food crops and seed sources
<p><u>Forestland uses until 1960s:</u></p> <ul style="list-style-type: none"> • Intact forests of natural origin • A good numbers of watersheds (annual and perennial for major water supply to the local population) 	<ul style="list-style-type: none"> • Fragmentation of natural forests into semi-natural or mixed ecosystems (bamboo with timber) or large grasslands • Man-made intensive plantations of commercially important timber plants (teak) increased in both government and private lands • Rubber and different pulp wood species increased as raw materials for government and private industries 	<ul style="list-style-type: none"> • Excessive logging for government revenue earning and infrastructural development • Illegal logging of trees and encroachment of forest areas • Clear felling methods • Pressures for increasing shifting cultivation areas • Increased demand for raw materials for industries 	<p><u>Positive:</u></p> <ul style="list-style-type: none"> • Increased cash incomes in a small number of households <p><u>Negative:</u></p> <ul style="list-style-type: none"> • Increased intensive use of commercial plantations, reduced agriculture cultivation areas • Declines of availability of forest and NTFPs can affect the livelihoods of subsistence users • Loss of watershed affects forest ecosystem services (i.e. small fish catch, irrigation, daily use of household water, climate regulation etc.)

In the long term, shifting cultivation may not be environmentally and economically appropriate in the region (Rasul and Thapa 2006; Bala et al. 2012; Rahman et al. 2012), where it is thought modification of shifting agriculture with intensive crop and fruit cultivation can reduce soil erosion, sustain production and meet the burgeoning demand for food. Different regional (CHTDB) and local government agencies (Department of Agriculture Extension) also attempted to change agricultural systems with either horticulture or rubber-based agroforestry practices at different scales. Recently, NGOs have also promoted horticulture-based land uses. However, the trends and effects of intensification for enhancing food security and the relationships with conservation of forests are not evident or documented.

6.5.2 Forest land-use changes

Historically, CHT was designated for forest resources, particularly as a source of timber harvesting in Bangladesh (Rasul 2007). But most of the forestlands are barren, covered with grass or with scattered trees and bamboo. At present, forest areas cover almost 70% of the total lands that are either natural, planted or grasslands with scattered timber trees and bamboo in the region. Natural forest only covers approximately 72,000 ha or only 15%–20% of the total forestlands in CHT. The remaining area is largely secondary forest with mixed natural and planted forests (i.e. a mix of naturally regenerating bamboo and planted timber species) and monoculture planted forests.

Most of the primary forest declined between 1700 and 1800 in the region, although there is no accurate information available on forest cover change for that period. Limited information on CHT for the periods 1960–80 and 1990–2005 show that natural forest cover declined during this time (FAO 2010). Data on historical changes in Kassalong and Rankhiang, the two major reserves in the region, showed that in 1963, natural forest cover was 172,000 ha, which declined to 84,000 ha in 1990 and to 70,000 ha in 2005 (FAO 2010).

Forest cover changes in CHT are due to the conversion of large areas into non-forestlands (i.e. agriculture, grassland and scattered tree patches). Tree harvesting and shifting cultivation has caused degradation of the forest landscape in CHT (Islam et al. 2007; Rasul 2007; Rahman et al. 2012). A gradual loss of trees either for revenue generation or through illegal felling and clearing/burning practices in shifting cultivation has increased the area of non-forestlands. Encroachment and illegal felling has caused the loss of 21,000 ha of planted forests and valuable trees of regenerating capacity in natural forests (e.g. garjan – *Dipterocarpaceae* spp.) throughout the region (Khan et al. 2012).

Deforestation is still higher in CHT compared to other forested areas of Bangladesh, although areas of monoculture plantations have increased or remained stable since the 1990s (FAO 2010). Altogether, approximately 90,000 ha of forested land (either natural or planted with timber and bamboo forests) have been converted into agriculture lands or grasslands (Khan et al. 2012). But the forest cover change on barren land is much higher at about 287,461 ha of lands (GoB and FAO 2013).

The underlying reasons for deforestation in the region are often related to agriculture systems and institutional arrangements. The state forest policy has inadequately addressed local realities and ecosystem capacity in the region. They focused on nationalization of forests with a focus on logging to feed the wood industries. Intensive plantation programs with monoculture species (mainly teak and *gamar* [*Gmelina arborea*]) for commercial clear felling caused severe loss of natural vegetation, soil nutrients and biodiversity. The construction of the Kaptai Hydroelectricity Dam in the 1960s affected 22,000 ha of forest and agricultural areas and displaced local ethnic groups from available cultivable lands.

Higher population growth in the region will cause direct and indirect pressures on forests and agriculture land uses for food production. Forest uses may be higher among the ethnic people in this region compared to other areas of the country. A range of traditional forest uses exists in the region for energy, wild foods, shelter and water. However, the trends in historical forest cover change may threaten the whole landscape in terms of declined ecosystem services necessary for local, regional, national and global benefits.

6.6 A brief summary of conservation practices in Chittagong Hill Tracts

The CHT region is topographically diverse with steep hills slopes, valleys and plain lands. This is one of few ancient formations of largely igneous rock in the Hindu Kush Himalayas (Khan et al. 2012). Most of its landforms comprise forests or grasslands, farming areas and watersheds. Historically, forest loss and agriculture land-use changes caused threats to loss of biodiversity including plants and animals, soil erosion and degradation of watersheds. The region remains a major focus for conservation practice as a way to improve biodiversity, ensure associated social and environmental benefits and sustain food production. Here we explain the conservation efforts in terms of forest and agricultural land uses in the region based on the available literature.

6.6.1 Forest conservation

Forests are an important repository of biodiversity, with the highest concentration of endemic species in the country found in CHT (Khan et al. 2012). However, there are no accurate estimates of total plant and animal populations currently available in the region. Over 20 different animals have become extinct in the last century or are facing various threats. Another 25 plant species are under threat of becoming extinct in the near future (Khan et al. 2007). As such, conservation of forest biodiversity is important to sustaining the valuable benefits it provides for the region. Many of the plant species have important medicinal uses. At least 69 plant species identified by local ethnic people contribute to primary health care (Khan et al. 2012). However, identification of total biodiversity and appropriate conservation efforts are poor at both local and national levels.

There are a few significant conservation efforts that the government has taken to date in the region. Most of the Forest Department's initiatives were centered on declaration of reserve forests, facilitating plantations and establishing management boundaries. Three large forest reserves (Sanghu-Matamuhuri, Kassalong and Rankhiang) consist of fragmented forest patches of natural and planted ecosystems. Two protected areas declared during 1980–90 are Pablakhali Wildlife Sanctuary (42,087 ha) and Kaptai National Park (5464 ha) (BFD 2015). However, there is not any systematic assessment of biodiversity in these reserves or protected areas.

From the 1970s to early 2000 the Forest Department also implemented plantation programs to restore degraded forest ecosystems (Khan et al. 2007). But monoculture plantation with teak and *gamar* trees in their program has increased vulnerability of the land system in the region. Teak planted areas often have lower undergrowth and little regrowth of natural vegetation. Soil erosion is one of the major problems in teak-based tree ecosystems, as it has caused degradation of natural watersheds (Hossain 2003).

During the 1980s and 1990s, the CHTDB also undertook fruit- and rubber-based agroforestry programs on 6986 ha of land for settling shifting cultivation practices (GoB and FAO 2013). The goals of the programs were to increase agroforestry practices for cultivating crops and to increase fruit/timber tree cover. It was thought that limiting the expansion of shifting cultivation practices might reduce loss of trees. However, the monoculture plantation approach failed to achieve conservation benefits due to the focus on increasing tree cover rather than restoring biodiversity (Islam et al. 2007). Though horticulture can have potential economic benefits, remote locations and limited market access constrains its long-term success.

Lack of adequate studies on biodiversity has thwarted effective evidence-based conservation practices for the region. The decline of natural forest is not well recorded or the government has not identified the remaining areas to be conserved. A few small patches of natural forest cover (approximately 700–800 ha) scattered throughout CHT are still sources of valuable plants and watersheds though these have not been largely recognized in national policy and practices (Khan et al. 2012). As part of traditional systems, communities manage these natural forest patches (i.e. sizes from 3–260 ha) as common resources for maintaining environmental health, in particular protecting watersheds. Since 1800, this type of natural forest was designated as village forest and this is still unique compared to other areas of the country.

There was no formal or external support undertaken for demarcation of spatial boundaries and documentation of any changes in biodiversity status of this forest commons. Only recently has this type of forest common received formal recognition and some NGOs have identified their spatial distribution and biodiversity. Community forests are now available in 112 patches across CHT. The village headmen that control the *mauza* maintain oral or written rules about activities (dos and don'ts) within these forests. The Arannayk Foundation (a national organization) has supported the community to effectively manage the forest and watersheds in a few areas and established a local management committee for monitoring and stopping any illegal felling, hunting, clearing and fire activities within the forest and nearby watersheds.

6.6.2 Conservation in agriculture systems

Conservation of soil and sustainable food production are twin development issues in CHT. Food productivity in shifting cultivation systems has declined due to soil erosion and associated reduction in essential soil nutrients (Islam et al. 2007). Conversely shifting cultivation has also been blamed for increasing soil erosion and unsustainable land uses. Until the 1980s there were also not sufficient programs for the improvement of these farming systems. In a few cases, the Department of Agriculture Extension and the CHTDB undertook experimental agroforestry and horticulture practices to conserve soil nutrients and improve farming in fragile hill slopes. Agroforestry systems comprise a modification of shifting cultivation into a combination of multistoried vegetation (crops, fruit and timber). In this type of practice, land remains covered with vegetation and soil erosion is reduced.

Improvement of existing agriculture systems gained momentum due to pressures of a large population on the limited lands to increase food production in the region. Bulk studies on CHT largely indicated that short-rotation in shifting cultivation for annual cropping has negative effects on ultimate food production capacity of the lands (Miah and Islam 2007; Rasul 2009; Rahman et al. 2014). By contrast, they emphasized fruit/tree-based systems as beneficial for conservation of soils, restoration of forests and enhancing food security. But switching into sustainable agriculture systems is still difficult due to existing demands for annual foods over the required long-term investments, time and constraints in tenure access.

6.7 Potential land-use zones in Chittagong Hill Tracts

Land uses in CHT can be divided into three broad zones (1, 2 and 3) depending on land use types, ethnic composition, population density, accessibility and crop intensity (Figure 6.7). Here we discuss the key characteristics of three land-use zones identified for the purpose of the Agrarian Change Project.

Zone 1

This zone covers the southeast part of Rangamati district and is bounded by Mizoram State of India on the east side (Figure 6.7). The zone is located in Farua union within Belaichari subdistrict in Rangamati district.

The only way to access the area is from Rangamati town by water transportation. Kaptai Lake separates the area from Rangamati town. People have to use water transport (motorized boat) to travel to the market and district town and it takes about 2–3 hours.

Most human settlements have developed in the center of the hills near to two community managed natural forests (each range from 70–90 ha on average). Kaptai National Park and government reserve forests are located within 45 km of the settlements. Households are sparsely distributed due to the nature of their farming systems and changing locations of shifting cultivation. Ethnic cultures also influence the settlement system. For instance, the Chakma community tend to scatter themselves, the Marma live closely together, the Mrung community live on the top of hills and the Tanchangya live in dense jungles or in remote locations.

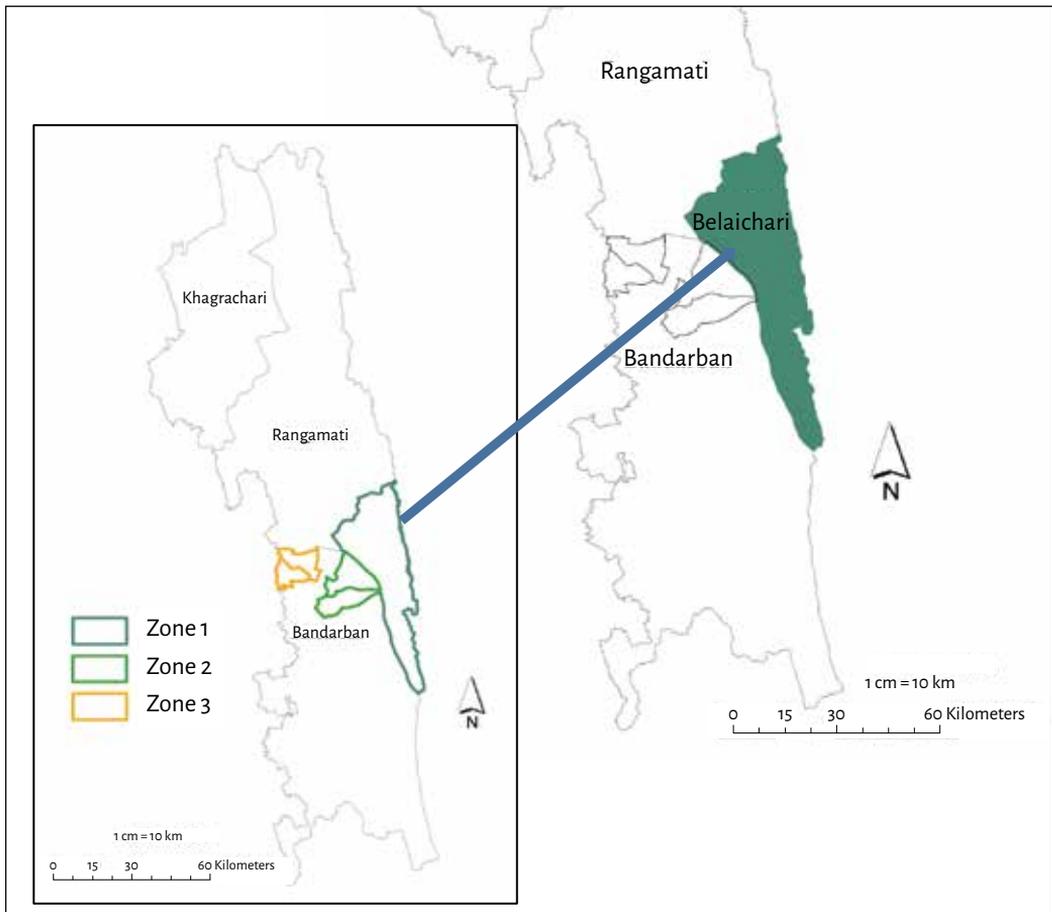


Figure 6.7 Map of potential land-use Zone 1 in the Chittagong Hill Tracts region of Bangladesh.

Source: Adapted from LGED (2015)



The main transportation system (left) and land used for single cropping subsistence farming (right) in Zone 1. (Ronju Ahammad/Charles Darwin University)

In the villages, people usually walk long distances carrying agricultural produce and necessary goods to visit local shops and neighbors. Both valley/plain lands and hill slopes are used for farming. A part of the lower lands remain seasonally submerged by water that is only cultivable for single season crop or fallow for cattle grazing. Key features of Zone 1 are summarized in Table 6.4. Four villages of Uluchari, Chainda, Pangkhu and Marma villages were selected for further study in this zone.

Table 6.4 Salient features of Zone 1.

Features	Description of the zone	
Potential sites	The site is located in Farua union within Belaichari subdistrict under Rangamati district. Uluchari, Chainda, Pangkhu and Marma villages are selected for further study in this zone.	
Population density	Average 46 persons per km ²	
Ethnic groups	<ul style="list-style-type: none"> • Chakma • Tanchangya • Pangkhua • Marma 	
Livelihood activities	<ul style="list-style-type: none"> • Agriculture • Seasonal wage labor (agriculture) 	
Land-use types	<ul style="list-style-type: none"> • More than 90% people use lands for agriculture to meet subsistence uses and income • Farming of different seasonal agriculture crops mainly paddy, beans, vegetables, tubers and turmeric • Single season for rice cultivation on valleys and hill slopes • Seasonal fallow lands used for cattle grazing and source of wild vegetables 	
Agricultural crops	Cash crops: <ul style="list-style-type: none"> • Banana • Groundnut • Turmeric • Beans 	Subsistence crops: <ul style="list-style-type: none"> • Vegetables (40% cultivated and 60% wild sources) • Paddy
Forest types	<ul style="list-style-type: none"> • Semi-natural forest patches • Mixed trees of bamboos, timber plants, herbs and shrubs • Monoculture teak plantation 	
Distance to forest reserves	Government forest reserve (0–1 km)	
Accessibility to market	2 hours travel by boat	
Forest ownership	Government owned forest reserve	
Forest uses	<ul style="list-style-type: none"> • Fuelwood (100%) • NTFPs, mainly bamboo • Building materials • Agriculture implements (e.g. a different size of crop/food grain store tool) 	
Electricity	<ul style="list-style-type: none"> • More than 80% use kerosene for lighting • A small use of solar panel 	
Health services	<ul style="list-style-type: none"> • A small, temporary clinic provides primary health services • No government facilities 	

Source: BBS (2015)

Zone 2

This zone falls in the southwest part of the CHT region and covers Rowangachari subdistrict in Bandarban district (Figure 6.8). The settlements are established in the valleys and on hill slopes and are located within 10–15 km of government reserve forests; there are no access rights to the government reserves except where there is private ownership of land within the reserves.

The area is well connected to the main town of Bandarban district. The north of the zone is bound by Rangamati district. It takes 30 minutes to travel to nearby markets/rural growth centers and 1 hour to reach Bandarban town depending on the mode of transport used (bus/motorbike) (Table 6.5).

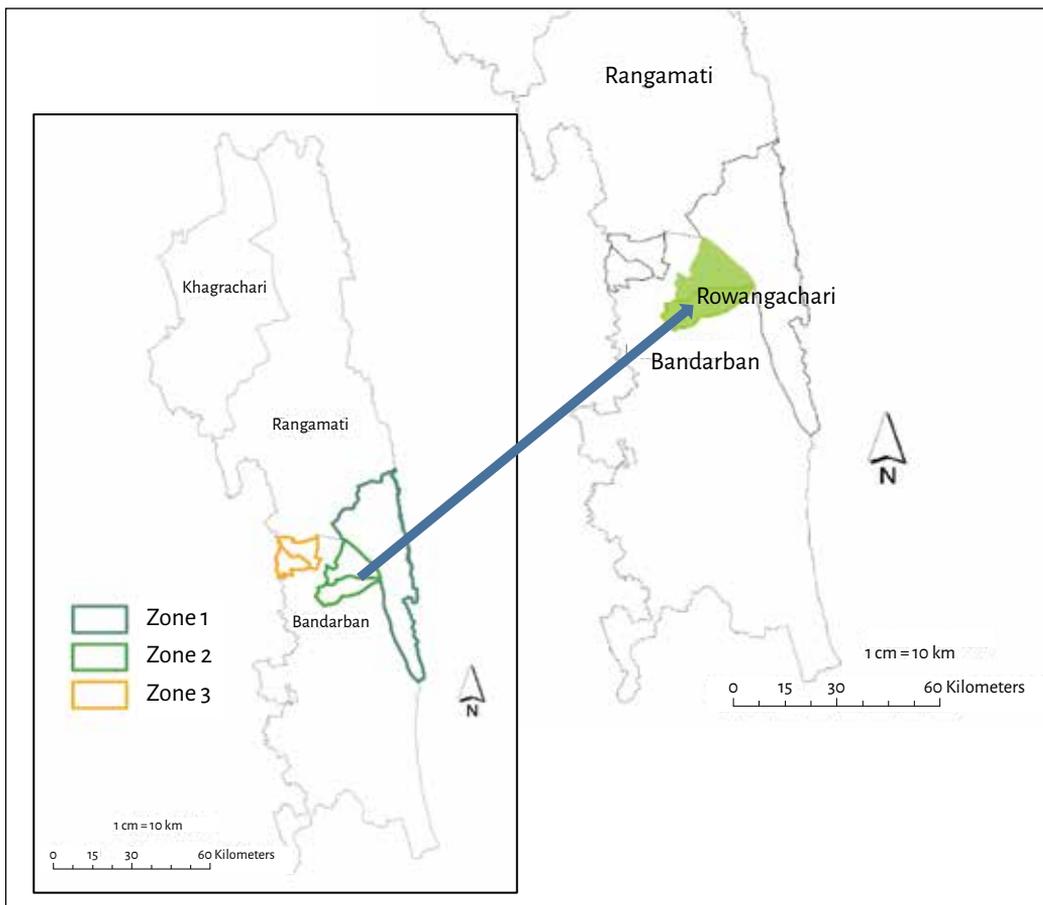


Figure 6.8 Map of potential land-use Zone 2 in the Chittagong Hill Tract region of Bangladesh.

Source: Adapted from LGED (2015)



Banana for subsistence use and cash income (left) and subsistence cultivation of rice crop (right) in Zone 2. (Ronju Ahammad/ Charles Darwin University)

Table 6.5 Salient features of Zone 2.

Features	Description of the zone	
Potential sites	The site is located in Rowangchari and Alikhyong union of Rowanchari subdistrict in Bandarban district. The four villages selected are Suanlu <i>para</i> , ^a Paglachera <i>para</i> , Aungad <i>para</i> and Bijoy <i>para</i> .	
Population density	Average 62 persons per km ²	
Ethnic groups	<ul style="list-style-type: none"> • Tanchangya • Bawm • Marma 	
Livelihood activities	<ul style="list-style-type: none"> • Farming • Wage labor (agriculture) 	
Land-use types	<ul style="list-style-type: none"> • About 70% of the lands are used for farming of different seasonal crops • Different fruits (i.e. banana, mango, cashew apple) are important for subsistence uses and cash incomes • Agriculture on valleys and shifting cultivation along hill slopes • Plantations with monoculture tree of teak 	
Agricultural crops	Cash crops: <ul style="list-style-type: none"> • Banana • Turmeric and ginger • Cashew apples • Ground nuts • Maize • Fruits (mango, lemon, pineapple) 	Subsistence crops: <ul style="list-style-type: none"> • Vegetables • Paddy
Forest types	<ul style="list-style-type: none"> • Community-owned natural forest patches • Government forest reserve • Mixed tree and fruit garden • Monoculture teak plantation 	
Forest ownership	<ul style="list-style-type: none"> • Customary ownership (locally called <i>para</i> reserve) • Government forest reserves 	

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Table 6.5 (continued)

Features	Description of the zone
Distance to forest reserves	<ul style="list-style-type: none"> • Community forest reserve (2–4 km) • Government forest reserve (10 km)
Accessibility to market	Half an hour travel on foot to regional market
Forest uses	<ul style="list-style-type: none"> • 90% of the people depend on fuelwood for cooking • 70%–80% use NTFPs (mainly bamboo) for own uses and cash incomes • Timber for building materials
Electricity	<ul style="list-style-type: none"> • 50%–60% of the area covered with grid electricity • Solar energy is also used • A small use of kerosine
Health services	Government and non-government community clinic available

a A village is locally known as a *para*.

Source: BBS (2015)

Zone 3

The zone covers the southeastern part of CHT and falls within the Bandarban subdistrict in Bandarban district (Figure 6.9). The west side of the zone is bordered by Cox's Bazar district, which has one of the world's largest coastal beaches and is a major tourism attraction in Bangladesh. The Sanghu-Matamuhri forest reserve is located on the east side of the zone.

This zone has the largest population compared to other areas of the CHT region. There is a diversity of ethnic groups including local ethnic populations (Marma, Bawm, Tanchangya, Mrung) and Bangalee people, who have coexisted throughout the last century in the area. A number of national and multinational companies have invested in tobacco-based agro-farming and rubber gardens to promote industrial raw materials. Road transport, availability of lands and government institutional support have allowed for easier access to company's investments (Table 6.6).



Intensive cultivation of tobacco in Zone 3 of Bandarban District (left), and monoculture crop and fruit garden in Zone 3 of the Bandarban District. (Ronju Ahammad/Charles Darwin University)

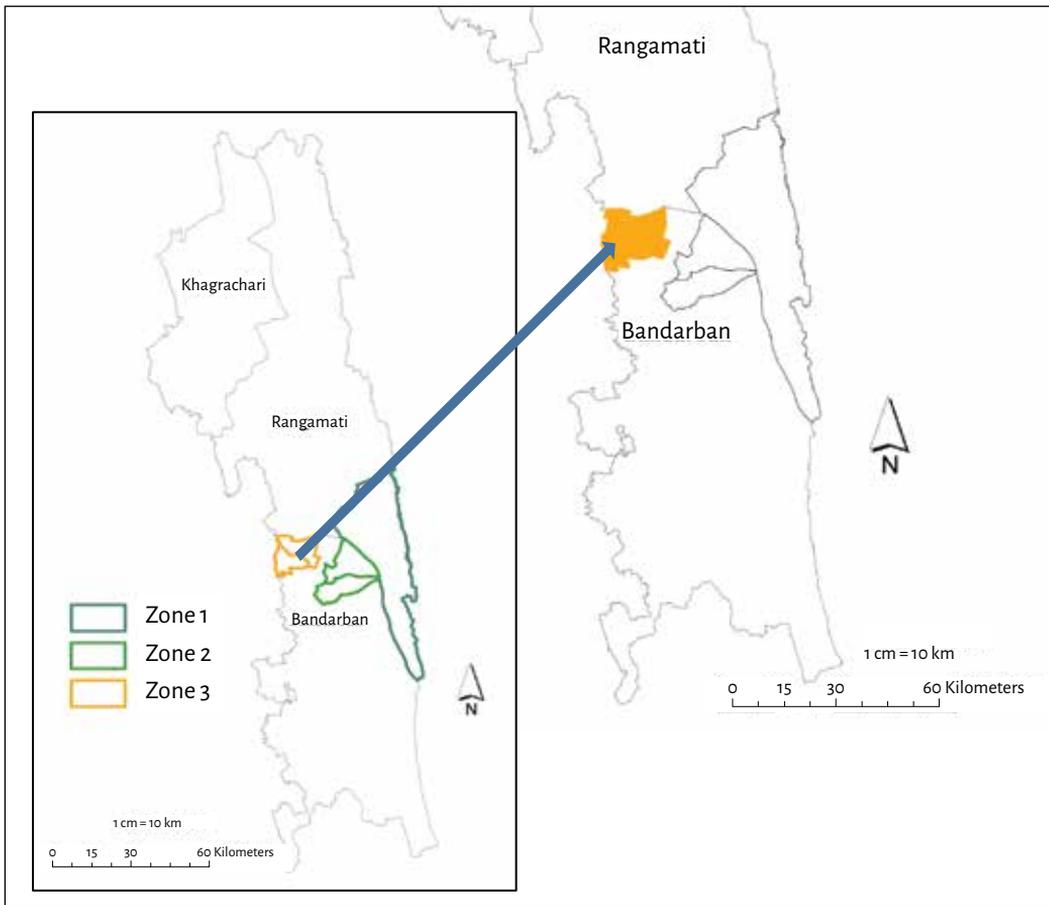


Figure 6.9 Map of potential land-use Zone 3 in the Chittagong Hill Tracts region of Bangladesh.

Source: Adapted from LGED (2015)

Table 6.6 Main features of Zone 3.

Features	Description of the zone
1. Potential sites	The zone covers (Khamadang <i>para</i> , Bagmara Headmanpara, Jogesh Karbaripara and Kamalong <i>para</i>) under Rajvila and Kuhlalong union of Bandarban subdistrict in Bandarban district.
2. Population density	Average 100–120 persons per km ²
3. Ethnic groups	<ul style="list-style-type: none"> • Marma • Chakma • Tanchangya
4. Livelihood activities	<ul style="list-style-type: none"> • Farming • Business (i.e. mainly agriculture related crops, fisheries and timber/fuelwood/NTFPs) • Wage labor in agriculture, sawmills, small mining etc.

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Table 6.6 (continued)

Features	Description of the zone	
5. Land use types	<ul style="list-style-type: none"> • More than 80% people use lands for farming of cash crops including different seasonal agriculture crops • Intensive land uses with monocropping practices of tobacco and paddy. • Plantations with monoculture of teak 	
6. Agriculture crops	Cash crops: <ul style="list-style-type: none"> • Tobacco • Fruit (mango, papaya) • Bean • Seasonal vegetables 	Subsistence crops: <ul style="list-style-type: none"> • Paddy
7. Forest types	Secondary tree vegetation mixed of degraded forest patches and plantations Monoculture planted forests	
8. Forest ownership	<ul style="list-style-type: none"> • Only government reserved forest exist where no access right for local community • Individual ownership in private forests 	
9. Distance to forest reserves	Government forest reserve (10–15 km)	
10. Accessibility to district market	15–20 minutes travel to district market by taxi/ 30 minutes walking distance to village market	
11. Forest uses	<ul style="list-style-type: none"> • Timber for building construction and income generation • About 50% use fuelwood for cooking while a number of people use for income 	
12. Electricity	<ul style="list-style-type: none"> • Most of area has grid electricity • A few households also use solar energy 	
13. Health services	Available government health services	

Source: BBS (2015)

6.7.1 Key agriculture crops and land uses in the three zones

Agriculture cultivation with annual crops (food and non-food), perennial fruit and timber tree seedlings are grown in all the zones. Depending on cropping intensity, infrastructural characteristic and land-use patterns, there is a variation in overall contributions to subsistence and cash incomes. In Zone 3, tobacco, seasonal vegetables and sugarcane are the dominant cash crops. Different fruit-bearing plants such as pineapples, jackfruits, mangoes, lemons and bananas are also cash crops in Zone 2. The fruit plants found in agroforestry systems (shifting cultivation plots) and home gardens provide subsistence income. Zone 1 is mostly dominated by annual crop cultivation and a small amount of fruit production that is mostly used for subsistence and limited to incomes to buy food. The key characteristics of the dominant crops and trees in the different land-use zones are summarized below.

Fruit

Fruit species are common sources of household foods and cash incomes in the region. Banana, pineapple, papaya, jackfruit, guava, lemon, litchi, mango, cashew apple and orange are the major fruit crops grown. Almost all crops have commercial values;

Zone 2 has the largest cultivation area of all three zones. Easy access to markets, agriculture inputs and extension services are the key factors that determine production. Hill slopes used for shifting cultivation in the past are now being planted with single or multiple fruit species.

A few fruit varieties are also cultivated annually in shifting cultivation lands and in home gardens in Zone 2. Banana is mostly cultivated in shifting cultivation lands while jackfruit is common in traditional home gardens of Zone 2. Compared to Zone 3, these are for commercial purposes, not subsistence. Fruit plants are also available in Zone 1 but these are largely used for subsistence rather than cash income.

In the last few decades, fruit production areas have expanded in the three zones of CHT. At least 30% of total land uses currently cover different types of fruit plantation in the region (Bala et al. 2012). This land-use practice improves farming systems through retaining vegetation on land and increases the quantity of food produced. But the potential benefits to food security are yet to be seen due to ineffective management of multiple crops and application of different agriculture inputs, particularly the use of fertilizers and pesticides. Planting fruit species as a replacement or complementary to traditional shifting cultivation practices may decrease land degradation (i.e. soil erosion) in the long term. Maintaining essential and available sources of diverse crop and tree production will be important in Zone 1, where limited alternative livelihoods exist and land degradation is severe.

Vegetables

The CHT region has enriched sources of a wide range of vegetables compared to other parts of Bangladesh. Both cultivated and wild types of vegetables are in demand locally as direct food uses and economic benefits for rural households. The quantity of cultivated vegetable areas is higher in Zones 2 and 3. Farmers in these zones have availability of plain lands, access to markets, good quality seeds, fertilizers and advanced training for improved farming. A significant amount of vegetables produced in different seasons provide household income to the people in these two zones. People cultivate those vegetables that are in demand in local markets. Vegetable cultivation is highly seasonal; land is often used for vegetable cultivation as it is not suitable for paddy or other cash crops.

The quantity of cultivated vegetables is less in Zone 1 compared to the other two zones. Most of the people in this zone follow traditional practices of shifting cultivation for growing diverse types of crops in their single plot each year. This type of annual crop combination can only meet the subsistence needs of diverse foods including vegetables and cereals. Limitations include lack of access to markets and intensive agriculture inputs. Therefore, it is not possible to cultivate any specific commercial vegetables or cash crops. To a large extent, the food production capacity of the people living in Zone 1 has decreased due to lower land fertility and less availability of productive lands. Despite the practice of maintaining a good source of different traditional seeds for annual cultivation from year to year, the vegetables are only sufficient for subsistence and are not an adequate source of income. Often, communities in this zone depend on wild vegetables for reducing their food shortage risks.

Tobacco

Tobacco is one of the six major cash crops alongside jute, cotton, sugarcane, tea, betel leaf and tobacco in Bangladesh. This is also one of the most important cash crops in almost all areas of CHT, particularly in Zones 2 and 3. Since 1984, the multinational British American Tobacco Company (BATC) has financed local growers on a contractual basis to cultivate tobacco. Now, there are about eight national companies involved in tobacco cultivation.

People cultivate tobacco in October–January and harvest in April–May of the following year. This largely occurs in Zone 3 where available plain lands are major areas for this non-food crop. In recent years, tobacco expansion increased by 304% in the region (Akhter 2011). Initially there was 300 ha of tobacco farming in Bandarban, which increased to 1922 ha in 2005–6 – an increase of 540%. In 2010–11, 4232 ha of land was cultivated with tobacco in Bandarban district (BBS 2011). The highest areas of tobacco farming are located in Bandarban and Khagrachari districts. At present, approximately 28,050 ha of land is cultivated for tobacco in Bandarban and 21,000 ha in Khagrachari (GoB and FAO 2013). This study reported the highest concentration of tobacco farming as a cash income in Lama subdistrict of Bandarban district.

Tobacco is largely grown as a monocrop by intensive farming (i.e. application of fertilizers, pesticides, irrigation and labor) for 6 months of the year. Although it has increasing acceptance among the local farmers as a cash crop, the economic benefits are less than the cost production inputs. As a result, there has been no increase in tobacco farming areas since 2007/2008 season. At present, tobacco farming competes with at least 20 food crops, causing a decline in availability of local food production areas and soil fertility. There are also negative effects on forests as tobacco curing, packaging and rolling tobacco for cigarettes requires a huge amount of fuelwood.

Sugarcane

Cultivation of sugarcane as a cash crop in the region is a growing prospect. In Zone 3, better communication, access to markets and extension services favor crop production. Plain lands and soil conditions are important for crop production, which is more available in Zones 2 and 3. At least 2300 ha of land were cultivated for sugarcane in 2014 in all three districts of CHT (Hossein 2014). Bandarban has the highest amount of production areas (1200 ha) and produced 4800 tons of the crop. Khagrachari has the second highest production area with about 850 ha cultivated in 2013–14.

Sugarcane cultivation has increased because of market demands from local and national markets and the introduction of high yielding varieties (chewing variety). In 2006, the Bangladesh Sugarcane Research Institute (BSRI) initiated a project on introducing sugarcane cultivation in CHT with necessary training and production inputs to farmers. In recent years, there has been a gradual increase in sugarcane cultivation areas. The advantage of intensive cultivation of sugarcane is that it can be cultivated with other crops, such as seasonal vegetables, for the first 5 months.

Farmers cultivate the crop in November–December and harvest in October–December in the following year. As a long, durable crop, the economic output is two times higher than production cost in this land-use system. On average, sugarcane production is

175,000 pieces per ha, equivalent to BDT 220,000/USD 2820 (USD 1 = BDT 78). However, it requires intensive farming inputs including water, fertilizers and labor for weeding and supervision for increasing the quantity of production.

Cotton

Cotton is a fiber cash crop in Bangladesh that has been grown for a long time. During the British colonial period, cotton was exchanged for land revenue in the region. CHT was famous for production of the finest quality white cotton. Karpas cotton, locally known as *pahari tula* (*Gossypium hirsutum*) is of superior quality in the markets compared to other local varieties found in Bangladesh. Although a decline in cotton production due to lack of high yielding and short-duration varieties, it still has market demand at local, national and international levels. Used as raw materials for the textile industries, annual demand of raw cotton is about 0.73 million tons in Bangladesh (CDB 2015). Bangladesh is the fifth largest user of cotton in the world and largely depends on the import of the raw materials for the local industries.

Farmers generally maintain cotton with their food crops to generate incomes in all zones. People in Zone 1 and 2 also cultivate cotton for small amounts of cash returns, but mostly for personal use (i.e. traditional household clothes). Cotton is maintained in Zone 1 for making traditional clothing, particularly winter clothes. Roughly 12,000 farmers cultivated 14,280 ha of hilly lands with cotton in CHT in 2013–14 (CDB 2015). There are three types of cotton varieties cultivated, hilly cotton with shifting cultivation crops and another two varieties in plain lands. Hilly cotton is cultivated in April–May and harvested in November–January and has no production input costs except labor. In 2014–2015, 5810 bales (182 kg/bale) were produced in CHT and total production in Bangladesh was 1.45 million bales. Despite the market demand within Bangladesh, there is an overall deficit in cotton production due to low agriculture inputs (i.e. yield varieties, land and fertilizer).

Rice

Rice is an important staple food crop in Bangladesh. It is the preferred food of most ethnic populations in CHT and is a major component of their three meals a day. In Zone 3, rice cultivation in monocropping systems is the dominant land-use system and the main source of generating cash income. There has been an increasing trend of plough agriculture cultivation of rice in two seasons, one is rain fed and another is using irrigation in the dry season. Most rice cultivation is now becoming intensive in Zone 3. Availability of plain and valley lands, access to improved high-yielding seed varieties and appropriate training and agricultural inputs are essential for rice production. However, Zone 2 has lower amounts of rice cultivation where irrigation is not adequate or where small areas of plain lands can only be used for one season.

The amount of rice production is lower in Zone 1 where people only cultivate the crop to meet their annual household demand. Most people use the traditional system of cultivating rice with other crops along the hill slopes. Shifting cultivation is the only practice that can produce a small amount of this food crop. Average rice yield per unit of land has been decreasing with this system due to increasing land fertility loss due to soil erosion, insufficient access to land, and competition from other high-yielding crop varieties has affected rice production in Zone 1.

People usually store local seed varieties from one season to the next so they require fewer inputs for rice cultivation in the traditional shifting cultivation system. There is less area available for maintaining rice cultivation with other cash crops; soil fertility has also been affected as a result of the productivity of shifting cultivation systems. People mostly produce rice for subsistence uses in Zones 1 and 2. While rice production capacity is likely to increase in Zone 2 and 3 due to available plain lands, this is insufficient to meet the food demand in Zone 1. The overall rice production capacity in CHT is low compared to other areas of Bangladesh. As a result, the existing rice production system will have negative effects on its accessibility and availability.

Teak plantations

Commercial teak (*Tectona grandis*) plantations are the most dominant land-use types in Zone 3, despite being prevalent in all zones. Better accessibility to transport, markets and availability of planting materials favors this land use in Zone 3. The economic value of timber is higher in local and national markets. A significant quantity of teak timber is harvested from private forests each year. However, accurate estimates on the amount of annual harvesting and contributions to rural household economies are not available.

Teak-based, smallholder economic activities have continued to expand in CHT. People manage teak in small patches in their home gardens and shifting cultivation areas. The tree cover is either a monoculture ecosystem or a mosaic of natural trees and different fruit plants in shifting cultivation lands. The use of land for teak is more common in Zones 2 and 3 where traditional crop cultivation is changing. People see more economic benefits from this tree-based land use though it takes a long time (15–30 years) before harvesting can take place. At present, people either convert traditional farming areas into fruit gardens or successively replace them with teak plantations. However, the contributions of increasing tree cover to household economies and the effects on food production systems are not yet evident.

6.8 Forest and agrarian transition in Chittagong Hill Tracts

Traditional land-use systems (i.e. shifting cultivation) may not be adequate to meet the food demands of large populations and maintain the multiple benefits of forests in CHT. Shifting cultivation was once a source of diverse foods although there is debate about its benefits in terms of subsistence compared to other economic activities; it has negative impact on the ecosystem such as lower productivity, loss of forest areas (due to forest clearing) and soil erosion. Food productivity from this traditional form of agriculture has reduced by half due to lower soil fertility and lack of adequate tree vegetation (Khan et al. 2007). More agricultural inputs (e.g. lands, seeds, technology for plough agriculture, extension services etc.) are required to increase food productivity in CHT.

Effective agricultural land use is vital to sustain food production and conservation in the region; achieving this will be challenging due to the complex problems and opportunities involved. A gradual shift from extensive to intensive cultivation of cash

crops, perennial fruit and timber trees has started in the last two decades. This has different manifestations in terms of access to lands, management patterns, remoteness and access to markets. These issues might have different influences on forests and agriculture systems and relationships with food production capacity at the landscape level.

Forests and trees have historically contributed to the livelihoods of traditional ethnic people in the CHT region of Bangladesh. Land-use changes may have direct and indirect effects on the associated ecosystem services provided by forests. Thus a detailed focus on diversity of trees and agricultural-based land uses will be essential to examine their management, roles in food production systems and overall effects at a landscape level.

6.9 Feasibility of the Agrarian Change Project in Chittagong Hill Tracts

The CHT region has been confronting multiple challenges on the sustainable management of its key agriculture and forest based land-use systems. Historical trends of forest and land-use changes discussed in this report have showed that the entire landscape underwent a dynamic social and institutional process during the last century. Initiatives by external institutions to intensify land uses or multi-strata agroforestry systems, managing forests and tree cover had a view to restoring degraded lands and conserving watersheds. But the current trends and the benefits of these diverse land uses to food security and conservation are yet to be fully explored across the landscape.

It would be worth investigating how agrarian change currently takes place in this landscape and in particular, the relationship with livelihoods, management and ownership of forests and ecosystem services. A better understanding on the utilization and management of forests and agriculture systems across the landscape will provide us with integrated landscape management options that are of national and regional interest as well as achieving global environment sustainability.

Considering the complexity of the social and ecological systems in CHT, we propose three areas or zones for future research activities. Drawing on the findings of the scoping study, 12 villages have been selected, four in each of the three land-use zones covering two districts (Rangamati and Bandarban) and three subdistricts (Belaichari, Bandarban and Rowangchari) (Figures 6.7, 6.8 and 6.9).

Further research into forest-based livelihoods, resource use, conservation and sustainability in this changing landscape will use a range of methods from household and farm surveys, key informant interviews, FGDs, participatory rural appraisal tools (e.g. farming typology, habitat evaluation, mapping of ecosystem services, historical trends, scenario development) and GIS mapping.

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