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RESEARCH PAPER

Role of Forest Income in Rural Household Livelihoods: The Case of Village Common Forest Communities in the Chittagong Hill Tracts, Bangladesh

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Abstract Forests play an important role in the livelihoods of ethnic communities living in the south-eastern region, the Chittagong Hill Tracts (CHTs), of Bangladesh. Over decades, deforestation and land degradation have markedly affected ethnic peoples' livelihoods in the CHTs. Although communities once managed extensive forest commons to support their livelihood needs, population explosion triggered fragmentation of common land leading to a gradual decline in livelihood opportunities. However, ethnic communities still manage the remnants of those once extensive common resources that are locally known as Village Common Forests (VCFs), which provide valuable resources for community use. An investigation was made of the role of forest income in livelihoods of selected VCF communities in Bandarban and Rangamati districts of the CHTs. Both quantitative and qualitative analyses were employed to examine the household livelihood system of the respondents selected at random from 7 villages. Data were collected through participatory rural appraisal and structured quarterly surveys. The contribution of all forest-related income was found to be much smaller (11.59 %) than that of agricultural income (77.02 %) in average total household income. However, VCFs provide bamboos, which are the largest source of household forest income. Moreover, they harbour rich native tree diversity which is vital for maintaining perennial water sources upon which most household livelihood activities depend. Therefore, it seems that rejuvenation of VCFs is crucial to support sustainable community livelihood in the CHTs. A strong political will is necessary to formalize the existence of VCFs in the land-use strategies for the CHTs.

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Introduction

Since pre-historic time people have depended upon forests for their livelihood. Although introduction of agriculture has much reduced people's direct dependence on forests, worldwide local and indigenous communities still harness resources from forests for household livelihood needs (Khan 1997; Rist and Dahdouh-Guebas 2006). In a number of recent studies involving analysis of poverty and income of the world's rural populations, scientists examined the role of forest income in people's livelihood (Bahuguna 2000; Perez et al. 2004; Adhikari et al. 2007; Mamo et al. 2007; Quang and Sato 2008; Mcelwee 2008; Babulo et al. 2008, 2009; Nath and Inoue 2009; Youn 2009; Kamanga et al. 2009; Miah et al. 2011; Bwalya 2011; Rahman et al. 2014; Angelsen et al 2014). In a few studies it was found that forest income contributed considerably to rural household income, for example, in villages of Madhya Pradesh, Gujarat and Orissa states in India (Bahuguna 2000), in highland areas of Northern Ethiopia (Babulo et al. 2008), and in dry areas of South Africa (Shackleton et al. 2007). However, in other studies scientists observed that the contribution of forest income to household livelihoods was relatively small, for example, in rural landscapes of China (Perez et al. 2004), and in areas of forest-based settlement projects of Bangladesh (Nath and Inoue 2009). Nevertheless, with limited opportunities for income diversification rural people living in the world's mountainous regions still mostly rely on forest and related resources to maintain their livelihoods (Sharma et al. 2009; Nayak et al. 2012).

Socio-economic and environmental changes led to transformation of tropical mountainous landscapes in Asia that resulted in degradation of forest ecosystems, introduction of monoculture plantations and agricultural intensification (Feintrenie et al. 2010; Yi et al. 2014). Increasing environmental degradation in the tropics has negatively affected livelihoods of people dependent on forests, forcing them to explore alternative sources of income to adapt to changing socio-environmental conditions. However, recent studies confirm that local communities across the tropics still use forest landscapes to support their livelihood needs through traditional farming practices and community management of forests (Agrawal et al. 2013; Padoch and Sunderland 2014). Community-managed common-pool resources or "commons" are a rich source of environmental income, and a crucial element in the livelihood strategies of the poor, particularly those who do not own land (Jodha 1986). However, common-pool resources that provide sustenance to poor communities have declined in numbers and areas in much of the world due to a combination of factors including privatization, agricultural intensification, and population growth, resulting in common property areas dwindling in size, quality and availability to the poor (Beck and Nesmith 2001).

The Chittagong Hill Tracts (CHTs) are parts of the larger Hindu Kush Himalayan mountain ranges situated in the south-eastern part of Bangladesh (Fig. 1), lying between 21°25′ and 23°45′N latitudes and 91°45′ and 92°50′E longitudes. The CHTs occupy about one-tenth of the country's land area that supports semi-evergreen sub-tropical forests. Moreover, the area hosts 12 ethnic groups which depend on forests for their livelihoods. Before the British invasion of the Indian sub-continent in the eighteenth century, the ethnic communities enjoyed unlimited access to the forest resources of the CHTs with no restrictions imposed on exercise of customary user rights over the resources (Roy 1995). The British colonial rulers and the successive governments, however, declared large areas of the CHTs as reserved forests making them off-limits to the hill people (Rasul 2007). Nevertheless, a considerable part of the remaining land base is used by ethnic communities

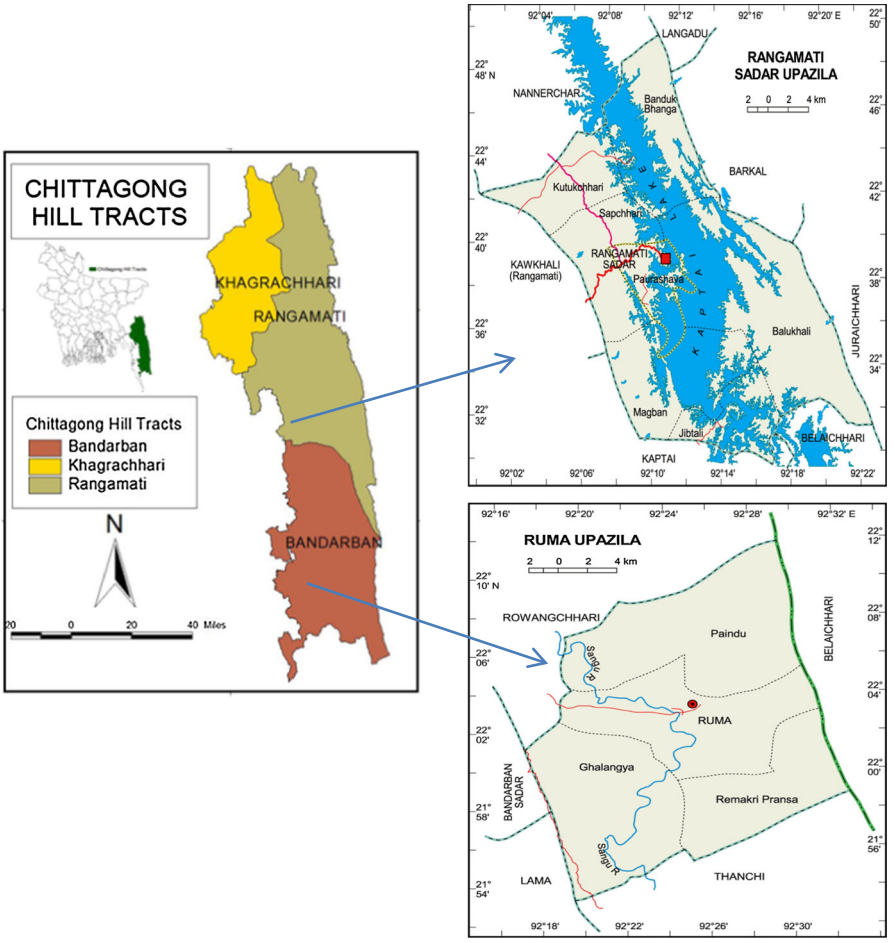

Fig. 1 Map of Chittagong Hill Tracts with locations of study. *Source*: Google, http://www.mapsofbangladesh.com

for traditional farming known as shifting cultivation, and for gathering other livelihood elements including fuelwood, fodder, construction materials, medicinal herbs as well as a variety of non-timber resources that often help bridging gaps in their livelihood needs.

Population explosion triggered by huge in-migration of plain land settlers since the 1980s (reported by Roy 1997) and government land-use policy that favoured clear-felling of natural forests for establishing mono-culture plantations has resulted in massive land degradation in the CHTs. An area covered with dense forests until the early nineteenth century is now mostly denuded with some scattered trees and shrubs remaining (Roy 1995; ADB 2001), except for the presence of monoculture plantations of mostly teak and rubber and horticultural gardens. Despite a massive degradation in forest ecosystems throughout most of the CHTs, in a few places ethnic people still maintain community-managed forests that occur across village clusters and are known as Village Common Forests (VCFs). VCFs are smaller forests ranging between 20.25 and 121.5 ha (Halim et al. 2006) occurring around labyrinthine networks of smaller watersheds upon which the poorer sections of the hill people depend for their livelihood needs. Committees selected from among the villagers and headed by the village head (*karbari*) manage VCFs with the help of customary rules. VCFs are the homes of diverse plant and animal life that support community livelihoods. VCFs are the main sources of bamboo and wood required for house building, medicinal products and other sustainable biomass needs of poor hill villagers (Khisa et al. 2006). As well as directly supporting community livelihood needs, VCFs serve crucial watershed functions because many of them contain headwaters of streams, natural springs and other aquifers.

An investigation preceding the present study that involved a comparative analysis of basic livelihood of the VCF and non-VCF communities indicated that VCF communities were more financially disadvantaged, and were therefore heavily dependent on forest resources to support their livelihoods as compared with their non-VCF counterparts (Misbahuzzaman 2007). Ironically, although the need for and the existence of VCFs were acknowledged in a quasi-formal manner in an amendment to the Government CHTs Regulation Act of 1900, no concerted attempts were ever made by government agencies to formalize VCF management systems (Halim et al. 2006). Over the last several decades, VCFs have declined both in number and in size due to government acquisition of land for making reserved forests to establish monoculture plantations, and landscape fragmentation caused by population explosion. Nevertheless, resource constraints caused by massive deforestation and restrictions that control people's access to the government-acquired reserved forests led to people's increasing dependence on community managed VCFs that provide necessary resources to support critical livelihood needs. The objectives of the present study were to explore major sources of livelihoods of the VCF communities of CHTs and to assess the role of forest income in their livelihoods.

The Study Area

The CHT cover an area of about 13.18 km^2 and consist of three hill districts: Khagrachari, Rangamati and Bandarban (Ministry of Chittagong Hill Tracts Affairs, Government of Bangladesh). Two-thirds of the area is characterized by steep slopes, the remaining area having an undulating topography (Rasul 2007). The mean annual total rainfall varies from 2400 to 3800 mm. The mean annual temperature is approximately 26 °C and the mean minimum and maximum temperature varies from 22 to 30 °C. High temperatures are experienced between March and October, and the lowest temperatures during the month of January. The mean humidity is approximately 76 %. Extreme climatic factors increase environmental hazards such as landslides, droughts and soil erosion. Heavy rainfall damages crops in the field and washes out top soil nutrients from barren land. The erratic behaviour of rainfall distribution poses a threat for timely agricultural crop production. A soil and land use survey conducted in 1966 revealed that 73 % of the land of the CHTs is suitable only for forest, 15 % for horticulture, and only 3 % for intensive terraced agriculture (Forestal 1966; Brammer 1986). Land is the sole means of livelihood and agriculture is the main occupation of majority people in this region. At present shifting cultivation and plough cultivation are both practiced.

Research Method

Selection of Villages and Households

Because difficult terrain conditions and lack of law and order restricting fieldwork in most areas of the CHTs, contacts were established with local Community Based Organizations (CBOs) who had working experience with people from VCF areas. After a successful communication with CBO representatives from Rangamati and Bandarban districts, the study villages were identified and prior consent from the village heads (*karbari*) was obtained. The CBO field representatives provided direct assistance in the reconnaissance surveys and subsequent fieldwork in the villages. A total of 7 villages including 2 (Empupara and Kurongpara) from Ruma Upazila (sub-district) of Bandarban District and 5 (Chaiggachari, Changrachari, Hajachari, Headmanpara and Madhyapara) from Rangamati Sadar Upazila of Rangamati District of the CHTs (Fig. 1) were selected purposively because they were more easily accessible for surveys on VCF household livelihoods compared with villages located in remote areas. In each village 10 households were selected at random. Thus a total of 70 households were contacted for interview. The names of households of each village were written on cards from among which households to be contacted for interview were selected at random.

Data Collection

The study involved participatory rural appraisal as well as annual and quarterly household surveys that were conducted using questionnaires developed by Poverty and Environment Network (PEN) of Centre for International Forestry Research (CIFOR 2014). The participatory rural appraisal generated preliminary information regarding community livelihood strategies and resource use culture. The PEN questionnaires were tested among 10 household heads. The questionnaire for the household survey included groups of questions about household composition, landholdings, land tenure and access, assets and savings, forest resource base, forest user groups, income, and local knowledge of forest use and conservation. The first and most intensive phase of data collection covered the 1 year period from December 2006 to December 2007. Detailed household interviews were conducted at the beginning of the period (December 2006) focusing mainly on demographics and assets, and at the end of the period (December 2007) focusing mainly on crises in and perceptions of the past year. Quarterly rounds of interviews were conducted between December 2006 and December 2007, focussing mainly on income earned at the end of four crop-production seasons, namely winter (Quarter 1 or Q1), summer (Quarter 2 or Q2), rainy (Quarter 3 or Q3), autumn (Quarter 4 or Q4).

Respondents were asked to estimate both the quantity sold and cash income raised from all agricultural crops and livestock (agricultural income), income from forest products harvested (direct-forest income) including processed products (forest-derived income) and wage labour in agriculture, business and trade (wage income) earned during each of the four major seasons: winter, summer, rainy, autumn. During 2007 collection of household income data for winter was performed in late February (Q1), for summer in late May (Q2), for the rainy season in late August (Q3), for autumn in late November (Q4) so that income streams generated throughout the last 3 months of each season could be estimated as accurately as possible. In order to compare livelihoods between various income groups, household income data were grouped into quintiles.

The CHTs experienced a number of natural disasters and hazards in the years between 2007 and 2012. There was a massive rodent outbreak in the CHTs that started towards the end of 2007 which continued till the end of 2008. The outbreak appeared with a huge bamboo mass-seeding event (Keeley and Bond 1999) which usually occurs in a 40–50 year cycle when the dominant bamboo species (*Melocanna baccifera*) in the CHTs flowers and seeds profusely. Rats devoured large quantities of bamboo seeds that fueled their reproductive rate after which they moved out into the agricultural fields and destroyed field crops, and also invaded people's houses and ate stored food. The rodents consumed most of the grain and cash crops (Belmain et al. 2010), forcing people to eat seed they would normally save for cultivation. The rodent outbreak set the stage for an increased attack of wild pigs and monkeys in 2009 and 2010 that caused further losses in crop production. Also in 2011 and 2012 there have been incidences of excessive monsoon (June–July) rainfall in the hills which resulted in massive landslides contributing to reduced crop production. During the surveys conducted in 2007, respondents did not mention about any major livelihood crises that occurred in that year or in the

previous year that might have considerably influenced their forest dependence in response to livelihood crises. Therefore, further fieldwork was conducted in November–December of 2012 to investigate the issues related to household livelihood crises that might have influenced household forest dependency.

Product Valuation and Pricing

The main method of agricultural or forest-related product valuation was estimation by respondents. Most products (vegetables) were traded locally and some (bamboos and timber) regionally. However, in estimating value for a few products which were marketed in district head quarters but not in local markets including fuelwood and thatching grass, the respondents were asked first how much the product would be worth in the distant markets and then the transport cost of local carriers required for marketing the products were subtracted from the distant market prices of those products to estimate local prices. In pricing the fodder for animals, respondents were asked how much they would be willing to sell the product for, and if they failed to guess, how much rice would they want in exchange of a headload of the product, the price of rice being easy to estimate. Differences in product quality and quantity were clearly reflected in price differences. Prices of goods, costs and income were entered as US dollars in case of all surveys except quarterly surveys, where they were recorded in Bangladesh Taka, Tk. Prices of items including bamboo and grass varied because of their varying sales unit sizes. For some vegetables species, prices varied due to varying distances from farms to markets. Costs of fertilizers and pesticides varied between types of chemicals used.

Results

Household Characteristics

The average household size, age of household head, household landholding, homestead size and size of land under house are provided in Table 1. All but one household surveyed was male-headed. Of the 70 household heads surveyed, 51 had no formal education (72.86 % of total). Out of 19 who were educated, a third had education of 10–12 years with the rest less than 10 years. Most of who were educated were from Rangamati with only one household head out of 20 surveyed in Bandarban had 10 years of education.

Table 1 Basic household characteristics of the sample households in Bandarban and Rangamati districts of Chittagong Hill Tracts (n = 70)

Item	Mean	SD
Household size (no. of persons)	4	1.15
Age of household head (years)	41	11
Household landholding (ha)	2.24	0.51
Homestead size (ha)	0.303	0.128
Size of land under house (m^2)	104.64	60.95

Fifty four out of 70 households had no assets and for those who had, asset value varied between USD 9 and 52. Only 8 had any non-productive asset such as gold and other ornaments the values of which varied between USD 43 and 300. However, 33 households had debt ranging from USD 27 to 115. Based on Adult Equivalent Units (AEUs) developed by the World Health Organization (WHO) (reported in Colier et al. 1986, and quoted by Cavendish 2002), the average per capita income of the VCF households surveyed was Tk 22,569 (USD 289.35) as against the country's average of Tk. 92, 820.00 (USD 1,190.00) (Bdnews24 2014) (1USD = Tk. 78.00 as of September 2014).

Household Income Sources

The sources of agricultural income were: agricultural crops consisting of rice; vegetables including cucurbits, calocasia and ladies' finger (okra); fruits including jackfruit, mango, pineapple, banana, papaya, coconut, lemon and guava; spices including turmeric, ginger and chillies; and livestock including cattle, goats, pigs and chicken. The direct-forest income includes income from bamboos, fuelwood, timber and poles, as well as relatively small quantities of wild fruit and vegetables, bamboo shoots, medicinal herbs, and fish from forest streams. The sources of forest-derived income were value-added items including baskets, brooms, house fencing and roofing materials made from bamboos and wood, thatching grass, broom grass and fodder grass collected from the wild. The source of wage income was wage labour engaged in agriculture, forest harvesting, agricultural product trading, small groceries shops and tea stalls. Agricultural crops were the biggest source of average total household income (77.0 %) followed by wage labour (11.4 %). About 58 % of all agricultural crops harvested contributed to average household subsistence needs, the remainder providing cash income. Rice, vegetables, fruits, turmeric and ginger contributed to most of the household agricultural income. The contribution of

Table 2 Percentage distribution of seasonal (quarterly) average household income (in Tk) in Village Common Forest (VCFs) communities of Chittagong Hill Tracts, Bangladesh

Season	Seasonal mean total income per household	Source of income			
		Agriculture	Direct-forest	Forest-derived	Wage
Winter	13,034	9988	1216	189	1641
(Q1)	(15.83 %)	(76.63 %)	(9.33 %)	(1.45 %)	(12.59 %)
Summer	30,129	21,020	5457	132	3520
(Q2)	(36.60 %)	(69.77 %)	(18.11 %)	(0.44 %)	(11.68 %)
Rainy	16,369	14,021	718	165	1465
(Q3)	(19.89 %)	(85.66 %)	(4.39 %)	(1 %)	(8.95 %)
Autumn	22,781	18,368	1497	163	2753
(Q4)	(27.68 %)	(80.63 %)	(6.57 %)	(0.72 %)	(12.08 %)

Figures in parentheses represent shares of major sources of income as percentages of the seasonal mean total household incomes in respective seasons or quarters

direct-forest income to average household economy was 10.80 % of which nearly one-third was used to meet household subsistence needs with the rest earning cash income. The contribution of the forest-derived income was 0.79 % which entirely contributed to meeting household domestic needs. However, the contribution of all forest-related income (including incomes from both direct-forest and forest-derived products) to average household total income was 11.59 %.

Income Sources and Seasonality

The contribution of seasonal average total household income was the highest for summer (36.6 %), followed by autumn (27.7 %), rainy season (19.9 %) and winter (15.8 %). In all four quarters or seasons, agricultural crops provided the highest relative average income per household which varied between 69.8 and 85.7 % across the respective seasons (Table 2). Households obtained their highest average relative agricultural income in Q3 or rainy season (85.66 %) followed by Q4 or autumn (80.63 %), Q1 or winter (76.63 %) and Q2 or summer (69.77 %). Average household relative forest income was the highest (18.11 %) in Q2 or summer followed by those in Q1 or winter (9.33 %), Q4 or autumn (6.57 %) and Q3 or rainy season (4.39 %). Average household relative wage incomes were fairly uniform (ranging between 11.68 and 12.59 %) across the quarters Q1 (winter), Q2 (summer), and Q4 (autumn) except in Q3 or rainy season when it was the lowest (8.95 %) (Table 2). Average household relative forest-derived income varied between 0.44 to 1.45 % across the 4 quarters or seasons, with the lowest (0.44 %) in Q2 or summer (Table 2).

Table 3 Income quintiles on the basis of average income per adult household member as adjusted by AEUs (in Tk)

Income by source	Income quintile				
	1	2	3	4	5
Average of all agricultural income	11,764 (76.30 %)	15,345 (77.94 %)	18,083 (78.97 %)	19,597 (75.24 %)	25,810 (75.12 %)
Average of all direct-forest income	1494 (9.69 %)	1982 (10.07 %)	3049 (13.31 %)	3084 (11.84 %)	3534 (10.29 %)
Average of all forest-derived income	143 (0.93 %)	116 (0.59 %)	166 (0.72 %)	253 (0.97 %)	242 (0.71 %)
Average of all wage income	2017 (13.08 %)	2244 (11.40 %)	1600 (7.00 %)	3113 (11.95 %)	4772 (13.89 %)
Average of total income	15,418 (100 %)	19,687 (100 %)	22,898 (100 %)	26,047 (100 %)	34,358 (100 %)

Figures in parentheses represent shares of major sources of income as percentages of the averages of total household incomes in respective quintiles

Income Composition of Household Income Groups

Based on income quintiles adjusted for household AEUs it can be observed that in any income quintile, the share of relative agriculture income was more than 75 % of the average total household income which ranged between 75.12 and 78.97 % among the quintiles. Average household relative direct-forest incomes ranged between 9.69 and 13.31 % among the quintiles with households in the median and upper quintiles (quintiles 3, 4, 5) having higher proportions of forest income (13.31, 11.84 and 10.29 % respectively) than those in the lower quintiles (quintile 1 and 2) of 9.69 % and 10.07 % respectively. On the other hand, share of relative forest-derived income in any quintile was less than 1 % of the average total household income for that quintile which ranged between 0.59 and 0.97 % across the quintiles. Shares of relative wage income ranged between 7 to below 14 % across the quintiles with the median quintile (quintile 3) having the least relative income share (7.00 %) while both the lowermost (quintile 1) and the uppermost (quintile 5) quintiles had the highest relative income shares (13.08 % and 13.89 % respectively) (Table 3).

Considering the income quintiles of only the household total forest income, it can be observed that households in the lower forest income quintiles (quintiles 1, 2) secured higher shares of relative forest income from bamboos (75.24 and 76.38 % respectively) and fuelwood (12.92 and 16.28 % respectively) than timber and poles (5.73 and 4.86 % respectively) compared to the households in the upper quintiles (quintiles 4 and 5). Although the shares of wild harvests across the forest income quintiles were very low (0.60–6.11 %), the households in the forest income quintiles 1 and 2 had relatively higher relative forest income shares from wild forest products (6.11 and 2.48 % respectively) compared to those of the households in the upper forest income quintiles (quintiles 4 and 5) or 0.99 and 0.60 % respectively. The

Table 4 Income quintiles as per components of forest income on the basis of average income per adult household member as adjusted by AEUs (in Tk)

Source of forest income	Income quintile				
	1	2	3	4	5
Average of all bamboo	547.60	1006.86	1433.39	1403.79	1980.64
	(75.24 %)	(76.38 %)	(64.35 %)	(40.95 %)	(36.40 %)
Average of all fuelwood	94.00	214.56	157.99	148.80	175.91
	(12.92 %)	(16.28 %)	(7.09 %)	(4.34 %)	(3.23 %)
Average of all timber and poles	41.69	64.06	607.19	1841.56	3252.81
	(5.73 %)	(4.86 %)	(27.26 %)	(53.72 %)	(59.77 %)
Average of all wild forest harvest (fruits, vegetables, bamboo shoots, medicinal herbs, fish)	44.50	32.72	28.88	34.01	32.6
	(6.11 %)	(2.48 %)	(1.3 %)	(0.99 %)	(0.60 %)
Average of total forest income	727.79	1318.2	2227.45	3428.16	5441.96
	(100 %)	(100 %)	(100 %)	(100 %)	(100 %)

Figures in parentheses represent shares of components of forest income as percentages of the averages of total household forest incomes in respective quintiles

households in the upper forest income quintiles (quintiles 4 and 5) secured more than 50 % (53.72–59.77 %) of their total forest income from timber and poles (Table 4).

Livelihood Crises and Forest Dependency

Most households (more than 90 %) mentioned that they were not happy about the way they grew their crops in the fields because they had to increasingly use fertilizers to maintain the levels of productivity up to a minimum level necessary for maintaining livelihood. The percentage of respondents using chemical fertilizers was 55 % in 2007 which increased to 70 % in 2012. Farmers reported two major reasons behind their increasing dependence on chemical fertilizers for crop production. Firstly, there was a general decline in crop productivity due to gradually declining soil fertility caused by shortening of crop fallow periods in traditional farming. Secondly, they believed that through application of chemical fertilizers in crop fields they could recover from losses in crop production caused by massive rat infestation events of 2007 and 2008 and subsequent destruction of crops by wild pigs and monkeys in the following years (2009–2010). Although buying chemical fertilizers was costly for the poor farmers, they felt compelled to maintain or enhance crop productivity by using them in their crop fields.

To cope with the losses in crop production over the years between 2008 and 2010, 50 % of members mentioned that they had to eat fewer meals per day, 30 % increased consumption of wild forest foods including wild tubers, leaves and fruits, 20 % worked as wage labourers, 40 % engaged in increasing fuelwood collection and for selling in local markets to earn cash income to supplement livelihood needs, and 30 % travelled deep into the forest to harvest bamboos because these were no longer readily available in areas where they lived. Although in the 2012 survey respondents did not quantify the amount of additional land that has been brought under cultivation of turmeric and ginger—the two important cash crops—since 2007 when the first round of data collection was done, most of them mentioned that over the years (between 2009 and 2012) total area of land brought under cultivation of these spice crops had increased. Farmers earned sizable cash income from selling turmeric and ginger that helped them overcome crises in livelihood.

Importance of Village Common Forests in Ethnic Livelihoods

The villagers who lost access to their former commons found themselves with little choice but to devise new methods of sustainable use of their scarce common resources including Village Common Forests. VCFs in the CHTs are ethnic people's innovation based upon their traditional resource management techniques to retain forest cover for long-term use. While most of agricultural income comes from traditional farming practices, a substantial proportion of their forest income comes from VCFs. Harvesting of forest produces in VCFs is done meticulously in order to maintain a sustainable flow of resources. Attention is also given to conservation of native tree diversity so as to maintain the watershed function of the landscape in order to ensure perennial water flows in the streams that provide water needed for

farming and domestic use. A ready availability of water from the perennial water bodies near VCFs helps households to bring all available land around their homesteads and other places under crop cultivation, which helps in diversification of household income. The VCFs also serve as sacred groves where community spiritual rituals are performed. While the material values of VCFs can be easily estimated in terms of harvested bamboos, timber and wild herbs, as reported by the households, their potential to provide environmental services such as biodiversity and watershed function as well as their spiritual significance for community social wellbeing remain important for maintaining integrity in community livelihood.

Discussion

The respondents were people who had little education and assets, and for whom agricultural crops provided more than two-third of the average total household income across all income quintiles. Previous studies in the CHTs also confirm a higher dependence of ethnic households on agricultural income (Nath and Inoue 2009; Miah et al. 2011; Rahman et al. 2014). Among the agricultural crops, sales of paddy rice, vegetables and fruit were more or less the steady source of household income, although turmeric and ginger also provided sizable household income.

The share of forest income to average total household income as estimated in the present study (10.80 %) was less than that a similar study conducted in Khagrachari area of the CHTs (16.5 %) by Rahman et al. (2014). However, in the sites of Rangamati and Bandarban where the present study was conducted, forest income earned by households mostly came from wild harvests of bamboos, wood and non-timber forest products (NTFPs), while in the Khagrachari site households earned a substantial amount of forest income through systematic harvesting of NTFPs from their agroforestry plots. In general, hill people work very hard during the summer and the winter seasons when they harvest or collect most forest products which contribute to higher average household forest income in these seasons compared to that in the autumn and the rainy seasons. All respondents in this study mentioned that they engaged in wage labour because their income from both agriculture and forest sources (both direct-forest and forest-derived income) was insufficient to meet regular livelihood needs. However, respondents reported that wage income was lower in the rainy season due to lower availability of work in difficult weather conditions. During the rainy seasons working in forests and farms as well as transportation of goods (mainly through human hauling as shoulder loads) is difficult because hill roads and trails become slippery to traverse.

It was found that households in the medium and the upper income groups had higher relative forest income than that of those in the lower income groups which is contrary to previous findings—e.g. by Cavendish 2000, Mahapatra and Tewari 2005—where lower income households were reported to be more dependent on forest goods than better-off households. The contribution of forest-derived income (income from processed forest products) to household livelihoods was consistently very low (less than 1 % of average total household income) across income

categories. It seems that there are demands in regional markets for processed forest products such as baskets and products made of bamboos and wood (Kar and Jacobson 2012a). However, currently no market incentives exist for the VCF households to engage in making these products and also they face transport uncertainties because they live in remote areas from where transportation of goods to the regional markets is difficult. In general ethnic communities in the CHTs are faced with lack of opportunities related to infrastructure, transportation and pricing of goods when it comes to marketing of forest products (Kar and Jacobson 2012a).

Households in the lower and medium income categories were found to depend more on bamboos (more than 60 % of the shares of their relative direct-forest income) compared to households of upper income categories, although absolute income from bamboos for the households of upper income categories were higher than those of the households of lower income categories. Bamboos are considered as poor peoples' timber in the CHTs. Also it was reported in a few other studies that income from bamboos is important for household livelihoods in the CHTs, e.g. Miah et al. (2011), Rahman et al. (2014) and Kar and Jacobson (2012b). The households in the lower income categories, however, had only small shares of their relative direct forest income from timber and poles (less than 6 %) compared to more than 50 % of the income in the upper income categories. In VCF areas management committees generally allow poor household members to harvest forest products most of which are non-wood products including bamboos and wild herbs. However, the richer households maintain private forests (locally called *jote*) from where they can harvest timber and poles. Also richer households using their linkages with timber traders in regional markets obtain higher prices for timber and poles.

The VCF communities do not harvest much timber or poles for selling, but rather depend more on income from bamboos and herbs harvested mostly from the VCFs. Bamboo patches that occur in the VCFs are relatively smaller compared to the thickest ones in government reserved forests. During the survey of 2012 on household livelihood crises, respondents reported that the rodent outbreaks of 2007 and 2008 mostly destroyed larger bamboo brakes in the government forests while the smaller ones in the VCFs were relatively little affected. Although the overall amount of harvestable bamboos declined in the years from 2008 to 2010 due to the rodent outbreak, the households were so heavily reliant on bamboos for cash earning that the adult members of the families had to travel deeper inside the forests to harvest just enough bamboo to sustain their routine livelihood needs.

While availability of usable water for domestic purposes has fallen in most parts of the CHTs (Misbahuzzaman 2007), it was observed that the VCF communities had better access to usable water because they maintained forest ecosystems within vicinities of their dwelling places that ensured maintenance of perennial water sources. It was also revealed that the VCF communities were more meticulous in gathering forest produce and strictly maintained seasonality in harvesting that helped in regeneration of resources and their conservation. In particular, the VCF communities place enormous value on conservation of native tree species which is required for proper maintenance of local aquifers and protection of the sources of headwaters for watersheds. In a parallel study by Baten et al. (2010), 173 native tree

species were found to occur in the study sites that have been maintained for protection of watersheds.

The VCF villagers have maintained collective funds from the income of the VCF products that provide for children's education and medical treatment of the disadvantaged families. Obviously, VCFs represent an alternative approach to forest management where the objective of management is not profit-oriented, but rather more service-oriented, in that the goods and services from VCFs support both material and spiritual needs of ethnic people, which helps develop social cohesion among them. More importantly, management of VCFs contributes toward effective conservation of forest, watershed and cultural diversity of ethnic people. While deforestation and land degradation have led to a gradual reduction in availability of forest resources that seriously affected livelihoods of ethnic communities, VCFs still remain as promising sources of bamboos, wild fruit and herbs that not only provide considerable forest income to the villagers but also act as safety nets during crises of livelihoods. Therefore, development agencies that work for the livelihood improvement of ethnic communities in the CHTs must recognize the importance of VCFs in local livelihood strategies and take steps for the rejuvenation of these community-managed forests. It is crucial that policy-makers come forward with a strong political will to recognize community management of forests and hence formalize the existence of VCFs in land-use strategies for the CHTs.

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