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Socioeconomic factors that favour forest conservation reducing forest dependency of local communities in developing countries: Lesson learnt from the Rangamati hill district in Bangladesh

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Abstract
Forests provide direct and indirect economic benefits to forest dependent communities in the world, especially in the developing countries contributing to the national economy. Present study was conducted to explore the socioeconomic status and factors favoring forest conservation and influencing people's dependency on forest resources in the Rangamati hill district of Bangladesh. The study was based on Focus Group Discussion (FGD) and socioeconomic survey through semi-structured questionnaire. Using generalized logistic regressions (GLR), this study has investigated the socioeconomic factors that favour forest conservation and influence people's dependency on forest resources. The study revealed that peoples' income from forest and forest-related occupations were positively aligned with their forest dependency. However, their education level significantly reduced their dependency on forest resources. Thus, educating the forest-dependent people, empowering the local and co-management communities and supporting alternative income generation activities may be an option for effective forest management and conservation. This study represents an important pioneer step in taking a holistic view of the peoples' dependency on forest resources which might be helpful for policy makers in future to ensure sustainable forest management and conservation in developing countries like Bangladesh.

Keywords: Forest dependency, forest income, livelihoods, socio-economic factors.

1. Introduction
People's dependency on forest resources is a multi-dimensional phenomenon due to the evidence that forests give a diversified benefits to humans being (Beckley, 1998) [9]. People rely on forests direct and indirect services such as for timber, non-timber products, recreational facilities, water water regime regulation, protection of soil erosion, conservation of biodiversity, sequestering carbon, ecological and environmental services. Conservation and management of forest areas in developing countries has been very complex and challenging due to higher level of dependency of local communities on forest products for agricultural, energy, nutritional, medicinal, and income related events (Adam and El Tayeb, 2014 [3]; Masozera and Alavalapati, 2004) [29]. Bangladesh being the developing country consisting the area of 147,000 km^2, with approximately 17% of its forest areas faces many management and conservation challenges related to forests whether it is natural or planted forests (Hossain, 2016) [22].

The total forest area of Bangladesh is about 2.53 million hectares (Hossain, 2016; Hossain, 2015) [22, 21] of which 84% has been classified as natural forest and 16% as plantation forest (Hossain and Hoque, 2013; Rahman *et al.,* 2010) [23, 37]. Bangladesh occupies diversified forest types (FMP, 2016) [17] ranging from wetlands, evergreen, semi evergreen, moist deciduous and mangrove forests comprising with diverse plants in each forest types (Bhuiyan *et al.*, 2014) [10]. Among these forest types, the evergreen and deciduous forests are mostly distributed in the hilly districts of Bangladesh. Combining three hilly districts namely Rangamati, Khagrachari and Bandarban Chittagong Hill Tracts covers about 13,294 km^2 of which more than 75% is considered suitable for forest resources (Hossain, 2016; Hossain, 2016a; Khisa *et al.,* 2006) [22, 28] and the forests of CHT are ecologically classified as Tropical wet-evergreen, Tropical semi-evergreen, Tropical moist-deciduous,

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Tropical open deciduous and Savannah forests (Hossain, 2016; Chowdhury, 2006) [22, 11].

The Chittagong Hill Tracts (CHT) in Bangladesh supports almost 80% of the country's total biodiversity (Hossain, 2016; Jashimuddin and Inoue, 2012; Nishat and Biswas, 2005) [22, 25, 35], and is inhibited by people from 12 ethnic groups (UNDP, 2009; Rasul, 2007; Rasul and Thapa, 2006; Miah and Chowdhury, 2004; Chowdhury and Miah, 2003) [38, 40-41, 32, 14] who depend largely on forest resources to fulfill their livelihoods (Misbahuzzaman, 2015; Miah *et al.,* 2012; Rasul and Karki, 2006; Rasul, 2007; Miah and Chowdhury, 2004) [38, 40-41, 32].

Forests contribute a significant portion of the economy (46%) at local and national levels, followed by crop/fruit production in the region (Rasul and Tripura, 2016; Ahammad and Stacey, 2016) [5, 39]. From the beginning of forest management, Rangamati hill district of Bangladesh was designated for forest resources, particularly as a source of timber both from the natural forests and also from the plantations (Ahammad and Stacey, 2016; Hossain, 2016) [5, 22]. But in course of time, most of the forestlands are becoming barren, covered with grass or with scattered trees, bamboos and weeds due to destruction of natural habitat of plants, over exploitation of natural green cover, conversion of large areas into non-forestlands, faulty management, jhum cultivation, invasion by exotics, land tenure ownership conflicts and so on (Akhtaruzzaman *et al.,* 2016; Hossain, 2016; Chowdhury, 2014) [22, 32, 12]. Traditionally, people have access to government forests in some cases yet their secure tenure rights have not yet been properly addressed (Khan *et al.,* 2012; Barkat *et al.,* 2010) [27, 8].

There have been many studies that have demonstrated the role of forest resources in strengthening the economic condition of forest dependent communities in both developed and developing countries of the of the world (Fernandes et al., 1988; Shackleton et al., 2008; Asfaw et al., 2013; Adam et al., 2013) [44, 4, 16, 2]. However, very few studies were conducted to evaluate the socioeconomic factors that favour forest conservation along with influencing the livelihoods of forest dependent communities (Gutanilake, 1998). Therefore, we conduct the present study to explore the socio-economic factors that favour forest conservation and affect people's dependency on forest resources and livelihood in Rangamati hill district of Bangladesh.

2. Methodology
Socio-economic condition of the people of Rangamati hill district was assessed through interview of the marginal dweller and Focused Group Discussion (FGD). Preliminary information about location, accessibility, communication means, and demography was collected from Conservator of Forest (CF) office of Bangladesh Forest Department (BFD), CHT Regional Council, different NGO's, literature and reconnaissance survey to the study area.

2.1 Description of the study area
The Chittagong Hill Tracts (CHTs) of Bangladesh is situated at the southeast region of the country (21°25 N to 23°45 N latitude and 91°54 E to 92°50 E longitude) and comprises three districts: Rangamati, Bandarban, and Khagrachari (Figure 1). This hilly forest region is traditionally resided by 12 ethnic groups, all with distinct cultures, languages, and traditions. We have selected two villages from the two separate union – Kaptai and Raikhali of Kaptai Upazila under Rangamati district.
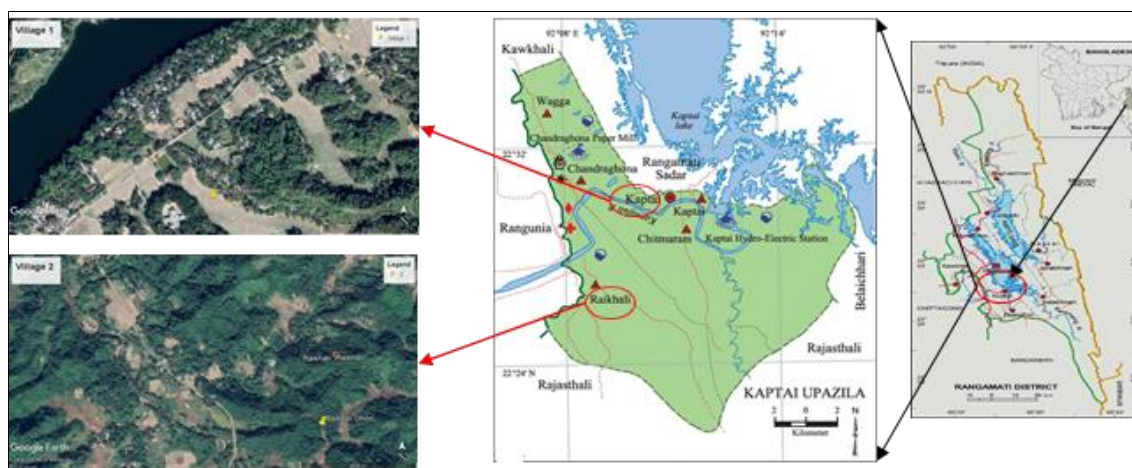

Fig 1: Location map of the study area comprising two villages (village 1 and village 2) at Kaptai Upazila under Rangamati hill district of Bangladesh.

2.2 Focus Group Discussion
Before starting for data collection from local people, a focused group discussion was conducted involving with the concerned NGO and *Karbari*. *Karbari* is the village head in each para who usually collects the tax from villagers and adjudicate disputes at village level and considered as the most powerful person in the village social structure. Both male and female members participated actively in the FGD. We conduct 2 FGD from two villages (1 FGD for each village) to collect necessary information related to the forests and the dependency of local communities on forests from the view of several socio-economic factors.

2.3 Interview of marginal stakeholder
A semi-structured questionnaire was used for interview of the local stakeholders in order to conduct socioeconomic survey. The questionnaire was designed to explore socio-economic status of the local people. Detail data on forest resource extraction and corresponding monetary income was collected from 60 respondents (30 respondents from each village) to assess their forest dependency.

2.4 Quantitative framework
Logistic regression model: Generalized linear model (GLM), popularly known as logistic regression model was

used in the present study to evaluate how people socioeconomic conditions affected their dependency on forest resources of CHT. GLM has been used in many socioeconomic studies. Mehta and Kellert (1998) [31], Sah and Heinen (2001) [42] and Holmes (2003) [20] have used GLM to determine impacts of demographic and economic variables. Holmes (2003) [20] has used logit model to identify the factors that determined people's forest dependency. Logistic regression has also been used by Ellis and Porter-Bolland (2008) [15] to associate the socio economic reasons to deforestation in Mexico. However, generalized linear model (GLM) are made up of three components: Random, Systematic and Link Function. The random component identifies the dependent variable (Y=0 or 1) and its probability distribution, the systematic component identifies the set of explanatory variables (Xi), and link function identifies a linear relationship between the explanatory variables and their probability function. That is,

$$f(Pi(Xi)) = \alpha + \beta i Xi \qquad (1)$$

Where, Xi is the vector of socioeconomic attributes of the respondents, Pi (Xi) indicates the probability of respondents' dependency on forest resources of CHT for their livelihoods (yes = 1, otherwise = 0) for a given value of Xi and βi is the vector of parameters to be estimated.

In generalized linear model, a logit link function can be defined as follows:

$$f(Pi(Xi)) = \log\left(\frac{Pi(Xi)}{1 - Pi(Xi)}\right) \quad \dots\dots\dots (2)$$

Combination of equations (1) and (2) gives equation (3).

$$Pi(Xi) = \frac{e^{\alpha + \beta i Xi}}{1 + e^{\alpha + \beta i Xi}} \quad \dots\dots\dots\dots(3)$$

Now, if Xi is binary, equation (1) yields the following outcomes:

If Xi = 1, f (Pi(1) = = α + βi and if Xi = 0, f(Pi(0) = = α

$$\beta i = f(Pi(1)) - f(Pi(0)) = \log\left(\frac{\frac{Pi(1)}{1 - Pi(1)}}{\frac{Pi(0)}{1 - Pi(0)}}\right) \quad \dots\dots\dots(4)$$

Where odds of Xi, = 1 and Xi = 0 are defined respectively

$$\frac{Pi(1)}{1 - Pi(1)} \text{ and } \frac{Pi(0)}{1 - Pi(0)}$$

The ratio of the two is called the odd ratio which represents the Odds that an outcome will occur (the probability of people's dependence on forest resources) given a particular exposure (Xi = 1) compared to the odds of the outcome occurring in the absence (Xi = 0) of that exposure. Thus,

$$\text{Odd ratio} = \frac{\frac{Pi(1)}{1 - Pi(1)}}{\frac{Pi(0)}{1 - Pi(0)}} \qquad (5)$$

Equation (6) can be obtained by combining equations (4) and (5).
Bi = log (Odd ratio)
So, Odds ratio = $e^{\beta i}$
Similar relationship can also be established if Xi is continuous.

Identification and definitions of variables
From focus group discussions and relevant literature explanatory variables have identified that might have leverage on the degree of people's dependency in the forest resources of CHT. To evaluate the factors affecting people's dependency in the forest resources of CHT, the dependent variable was Dependency. Dependency = 1 if the percentage of total household income was 20% and above from the forest resources and 0 otherwise. The associated explanatory variable were Forest income, Education level, Family size, Age and Occupation. Forest income= Forest income in thousand BDT, Education level = Number of schooling year, Family size = Number of family member per household, Age = Age of respondents in year and Occupation = 1 if respondents occupation is Jhum, 3 if Gardening (Practicing horticulture in the hills) and 2 otherwise (not related to forestry).

3. Results and discussions
3.1 Socio economic conditions of the respondents
Demographic and educational status: The study revealed that on an average age of the respondents was (34.66 ± 2.58) years and illiteracy rate is about 16.7%. Education of most of the respondents is up to secondary level (Table 1).

Table 1: Demographic and educational status of the respondents

Name (District)	Age (Years)	Education level				
		Illiterate (%)	Primary (%)	SSC (%)	HSC (%)	B.Sc. (%)
Rangamati	34.66± 2.58	16.7	22.2	38.9	16.7	5.6

Family size and income: The demography showed that on an average more than 5 people live in each family (calculated value 5.56 ± 0.36 individual) and monthly average income of the respondent is about (BDT 15,722.22 ± 2847.70) in the study area (Table 2).

Table 2: Family size and monthly average income of the respondents

Name	Family size (No./HH)	Monthly average income (BDT/HH)
Rangamati	5.38 ± 0.36	15,722.22 ± 2847.70

Occupation of the respondents: Jhum or shifting cultivation in the nearby hills is the major occupation of the respondents in CHT. Jhum or shifting cultivation (Jhum cultivation is also known as the slash and burn agriculture, is the process of growing crops by first clearing the land of trees and vegetation and burning them thereafter) and mixed

fruit gardening were the main occupations of the respondents of Rangamati. About 50.0% of the respondents are associated with jhum and crop cultivation of that area. They cultivate various crops in the nearby occupied hills. The lands are kept fallow for one or two years after harvesting of the cultivated crops. Mixed fruit gardening appeared as a prominent sector for income generation since 17.0% people mentioned it as primary occupation (Table 3). About one third of the respondents (33.0%) in this district is associated with non-forestry professions such as labor, teaching, engineer, business and service holder which is quite higher compared to other two districts of CHT (Table 3).

Table 3: Primary occupation of the respondents

Name	Jhum (%)	Fruit gardening (%)	Agriculture (%)	Others (%)
Rangamati	50.0	17.0	0.0	33.0

Forests are the source of livelihoods for hundreds of millions of people worldwide especially in developing countries (Jashimuddin and Inoue, 2012; FRA, 2010) [25, 18]. Forest has always played a vital role in the economy of the indigenous people of CHT (Chowdhury *et al.,* 2007; Rasul, 2007; Halim and Roy, 2006; Miah and Chowdhury, 2004; Chowdhury and Miah, 2003) [13, 38, 32, 14]. Household fuel-wood, food, medicines, shelter building materials and agricultural implements are common uses of forest resources in Bangladesh (Jannat *et al.,* 2018) [24].

Shackleton *et al.* (2007) [43] mentioned that millions of South Africans derived direct benefits from forests and the contribution is approximately 20% of their livelihood. They also noted that forest resources are not a means of alleviating poverty for millions of people, but rather that they provide resilience in their livelihoods, thus preventing intensification of poverty. Bahuguna (2000) [7] found the differences in rural communities' forest dependency in the Madhya Pradesh, Orissa, and Gujarat states of India which has similarities with the present study. Kamanga *et al.* (2009) [26] stated that the poorest segment depends more on forest than the least poor group. Miah *et al.* (2012) [33] reported that degradation of forest resources are constantly associated with deepening poverty and livelihood vulnerability. Miah *et al.* (2012) [33] found that dependence on the forest resources was influenced by easier forest access, the number of foragers from a household and family size.

3.2 Socioeconomic factors affecting people's forest dependency and livelihoods

For the management and conservation of forest resources i.e. timber, fuel wood, Bamboo, Broom stick, medicinal plants, fish and other NTFPs (Non-Timber Forest Products) of Rangamati hill district, it is important to address the needs of the people whose livelihoods are heavily dependent on the forest resources. Thus, one of the major aims of this study was to identify the major socioeconomic factors that governed people's degree of dependency on forest resources. Table 4 shows how the socioeconomic forces determined the local people's degree of dependency on forest resources. Of the six factors under consideration, Occupation and Education_level were found significantly contributing to a respondent's dependency on forest resources.

The parameter estimate of Occu2 was -1.2568, which was significant at 10% level (Table 4). The result indicates that respondent's non-forestry occupation was inversely related to their degree of dependency on the forest resources of Rangamati district. Again, the parameter estimate of Occu3 was 2.9991, which was significant at 5% level (Table 4). As expected this finding indicates that, the log (Odds) of forest dependency of a respondent with a forest related occupation (Gardening / Horticulture / plantations in the hills) was greater than that of a respondent with a non-forestry occupation by 2.9991. Thus, we conclude that people were more likely to depend on forest resources if they worked in professions that required forest resources as inputs. Forest conservation is almost impossible without the support from the local community. Macura et al. (2011) [30] reported that local people who had better access to forests, the forests were more aware of forest protection.

Table 4: Factors affecting people's dependency on forest resources

Variables	Estimate	Std. Error	Odds Ratio	z value
(Intercept)	6.4309	5.5617	620.7323558	1.156
Age	0.0076	0.0937	1.007628953	0.082
Occu2	-1.2568	1.5621	0.284563173	-0.805•
Occu3	2.9991	1.7006	20.06746807	1.764*
Education level	-0.9875	0.3899	0.372506795	-2.533*
Forest income	0.8194	0.4104	2.269137946	1.996
Family size	-0.5839	0.5417	0.557719015	-1.078

Notes: • Significant at 10% level and * Significant at 5% level; Dependent Variable = Forest Dependence (1 if dependent, 0 otherwise); Age = Age of respondents (Years); Occu = Occupation (1 if Jhum or Agriculture; 2 if labour/teacher/business/others (except forest related); 3 if Gardening/Horticulture/plantations in the Hills); Education level = Education (No of schooling year); Forest income = Forest income (in thousand BDT); Family size = Family size (Number of family members).

Respondent's education level was inversely related to their degree of dependency on the forest resources. The parameter estimate of Education level was -0.9875, which was significant at 5% level. An increased year of schooling of a respondent decreased his log (Odds) by 0.9875 (Table 4). The reasons might be two – firstly, an educated respondent might have better understanding about the importance of nature conservation and secondly, he might have managed to have a better and alternative income source elsewhere. This is an important finding in the sense that forest resources could be better managed if the forest dependent people could be educated. Similar findings were reported by Jannat *et al.* (2018) [24] and Rahman *et al.* (2017) [36] and Adhikari (2004) [1] who mentioned that educated people are less dependent on forest resources.

4. Conclusion

Forests provide a wide range of environmental services including biodiversity conservation, watershed protection, soil protection, and climate change mitigation. In addition to providing environmental services, forests are critical in meeting numerous human needs for water, food, shelter, medicine, fuel wood, fodder and timber.

Land tenure ownership conflicts, lack of effective management, inter sectorial policy conflicts, people's extensive dependency on forest resources coupled with their

ignorance about the environmental importance of these resources have caused severe depletion and degradation of forest resources in Rangamati in the last couple of decades. The diminishing and depleting natural resources in the developing countries like Bangladesh is not uncommon.

The situation demands bridging the gap between the indigenous communities and the ruling power including Forest Department. Forest protection efforts without the cooperation of the local people failed in most cases when their traditional rights on forest, which they enjoyed for generations, were ignored. For this, it is important to evaluate identification of the driving factors that affect their livelihoods is also equally important. People's income, education and forest dependency are the major factors significantly affecting their perception and attitude towards forest conservation. People should be motivated, focusing on the socio-environmental benefits from forest, to divert their negative attitudes towards forest conservation.

Conclusively, people from developing countries like Bangladesh are directly or indirectly depend on forest resources for their daily needs. From this study, we conclude that consideration of socio-economic factors of the local communities who are living around the forests is important for future policy formulation and decision making process towards sustainable management and conservation of forests in developing countries like Bangladesh.

Acknowledgement

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