

RESEARCH ARTICLE

LIVELIHOOD DEVELOPMENT IN THE HILL ECOSYSTEMS OF BANGLADESH: THE ROLE OF AGROFORESTRY

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ABSTRACT

Agroforestry plays an important role in hill ecosystems by developing a combined production system integrating trees and crops. The primary aim of the study was to determine the impact of agroforestry practices on the livelihoods of the respondents in the hill ecosystems of Bangladesh. This study comparatively assessed 100 smallholder agroforestry farmers' livelihoods in the hill ecosystem (Rangamati and Bandarban districts). An immense and in-depth field visit was conducted from June 2018 to August 2019, interviewing the farmers through both open-ended and closed-ended semi-structured questionnaires. Group discussion was also used to retrieve qualitative data. Five livelihood capitals: human, physical, natural, financial and social showed a mixed impact on agroforestry farmers' livelihoods. The respondents were mostly (34%) young (20-30 years old), illiterate (44%) and experienced in farming (64%), but interested in adopting agroforestry practices for their livelihood maintenance. The financial capital is gained through crop income, farmers' ownership of high-value equipment (motorcycles or thresher/dryer), and lease tenure of land. Farmers appear to have similar access to physical and natural capital and relatively higher access to social capital, although livelihood resources are interrelated. All these observations come together into a picture of the hill people's socio-economic and farming characteristics. Farmers' livelihoods are improved tremendously by practicing agroforestry as they've further access to food, fodder and fuel lumber, which is reflected by greater access to livelihood capital. Despite the prevalence of location, the sensitive questionnaire (income range) and the search for solutions to problems through group discussion are limitations of this study. Further research is recommended to more thoroughly investigate the impact of agroforestry systems on farmers' livelihoods.

Keywords: Agroforestry practices, Bangladesh, Chittagong Hill Tract (CHT), Livelihood assets, Smallholders

INTRODUCTION

Livelihood is a set of essential activities of daily living that are carried out over one's lifetime. Improving the quality of life of marginalized people by providing their basic needs (food, water, shelter and clothing), livelihood opportunities and protection refers to livelihood development, which gives them hope to make a constructive contribution to the community. Agroforestry is one effective way to resolve the trade-offs between economic, environmental and social benefits as it can

simultaneously contribute to nutrition security, improved rural livelihoods and a variety of environmental benefits (Nair 1990; Islam *et al.* 2013, 2015). It is a sustainable and eco-friendly system (Hanif *et al.* 2015), which can meet the socioeconomic needs of people (Sharmin and Rabbi 2016; Chakraborty *et al.* 2015). Rural families' livelihood depends on the positive social and economic aspects of an intensive land management system to meet their food requirements (Saxena 1994; Thapa and Weber 1994). It also increases species assortment, ensures economic return and

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sustains the farmer's livelihood (Hanif *et al.* 2018).

Population growth has a huge impact on the livelihood of smallholder farmers (Josephson *et al.* 2014). Bangladesh is one of the most densely populated (total population is 166.5 million and density 1119 per sq.km.) country in the world, having a growth rate of 1.22% per annum (BBS 2022). The agricultural land has decreased by an average of 26,000 hectares each year, which is 0.29% of the total agricultural land over the last 40 years (Alam *et al.* 2015). Furthermore, per capita land holding is less than 0.10 hectares, and this figure is steadily declining (FAO 2015). The most basic resource in Bangladesh is agricultural land, which is the single largest production sector (about 70% of the population is dependent on it) of the economy and it contributes about 10.25% of the total Gross Domestic Product (GDP) of the country in 2018-19 FY (BBS 2020). According to Quasem (2011), agricultural land is being converted at 0.56% per year to non-agricultural use due to high population growth (1.22% per year as of BBS 2022), and the establishment of new industries, houses and other infrastructure which makes the situation very worse due to enormous pressure on the natural resources of the country, especially on the forest lands.

The rural households of Chittagong Hill Tract's (CHT) 66% depend mainly on agricultural activities as the main source of livelihood of the majority of the hill dwellers including ploughing lands, shifting cultivation, fruit gardening, paid labour, planks and logs production, livestock and poultry nurturing, and unrestricted fishing. Of these, 33% are engaged in plow cultivation only and 20% in jhum cultivation only, while the rest combine both plough and jhum cultivation (UNDP 2009). More than 35 crop species are grown annually in hilly areas (Ahammad and Stacey 2016). In the northeastern hills, the agroforestry system is the most dominant farming practice by hill dwellers (Mukul 2014; Haider *et al.* 2013). There's a tremendous possibility for growing high-value crops such as fruit, vegetables, medicinal and aromatic plants in hilly areas under an agroforestry

system (Rasul and Tripura 2016). So, combined production by integrating different plant species will be a viable technology for the development of livelihoods in the hill ecosystem of Bangladesh (Jewel *et al.* 2019).

The level of economic status may be an important indicator in determining one's livelihood. Only a couple of successes have been achieved in eradicating rural poverty, although new ideas are developing and new approaches to rural development are being deliberated (Carney 1998). The World Bank (2004) estimates that 1.2 billion people practice some form of agroforestry on their farms and their community lands. However, considering this, the objectives were to evaluate the role of agroforestry practices in livelihood improvement and determine the status of livelihood improvement of rural people in hill areas.

Theoretical Framework

People's livelihood development comprises five core kinds of capital upon which livelihoods are built: human, social, natural, physical and financial capital (DFID 1999; Scoones 1998). Agriculture and forests, as natural capital, play an important role in the livelihoods of poor people through the provision of food, energy, construction materials, medicine, fodder and agricultural implements (Warner 2000; Adedayo *et al.* 2010; Tumusiime *et al.* 2011). Considering various resources, activities, techniques and other factors commonly necessary for livelihood (Chambers and Conway 1992). The Institute of Development Studies (IDS) and thus the International Institute for Sustainable Development (IISD) established the Sustainable Livelihoods Analysis (SLA) procedure to identify the important assets of livelihood (physical, natural, human, financial, and social capital) from the mid-1980s (DFID 1999). As defined by SLA, It is the ability of a unit to strengthen its assets in the face of external threats (Castaneda 2000; Stephen *et al.* 2009). Many scholars have also studied different topics, like livelihood diversity in rural development (Ellis 2000), poverty alleviation (Barrett and Swallow 2004; Erenstein 2009), and natural resources

management (William 2003). The most of the literature on this topic has mainly focused on qualitative analyses of livelihood development addressing specific issues, and few studies have attempted to measure livelihood resources at a micro level with different research backgrounds.

Now a day, agroforestry has advanced as a science-based pathway for achieving essential purposes in natural resource management and poverty alleviation (Garrity 2006). Babulo *et al.* (2018) used that sustainable livelihood approach by DFID (1999) as a framework for the assessment of livelihood development in an attempt to identify the factors that influence a household's choice of livelihood strategy, with a particular focus on the extraction of, and dependence on, agroforestry products in hill people in Bangladesh (Fig. 1).

The improvement status of farmers practicing agroforestry is presented according to different livelihood resources, which identified distinct livelihood strategies in the household survey in the study area. This livelihood framework is widely utilized in contemporary studies, not just for poverty eradication but also for socio-economic development and sustainable management of natural resources.

MATERIALS AND METHODS

During the period of June 2018 to August 2019, an extensive survey was conducted to determine the livelihood development status of agroforestry practiced farmers in two selective districts named Rangamati and Bandarban in the Chittagong Hill Tract (CHT). These two districts, along with Khagrachari hill district are collectively known as the CHT of Bangladesh.

According to BBS 2013, a total of 69,531 households (29,144 from Bandarban and 40,387 from Rangamati) were obtained in the study areas. Among these, 100 households were randomly but pervasively selected considering a 5% margin of error, a 68.3% confidence level, and 50% response distribution through the online sample size calculator "RaoSoft (www.raosoft.com/samplesize.html)" in hill areas for an extensive and comprehensive field/household survey of the Buddhist community. In Rangamati, 50 farmers were selected from Kaptai (25) and Sadar (25), and in Bandarban, the rest of the 50 farmers were selected from Sadar (10), Ruma (30) and Thanchi (10) in the Hill Ecosystem (Fig. 2).

A semi-structured closed and open-ended pre-tested questionnaire was used to collect both

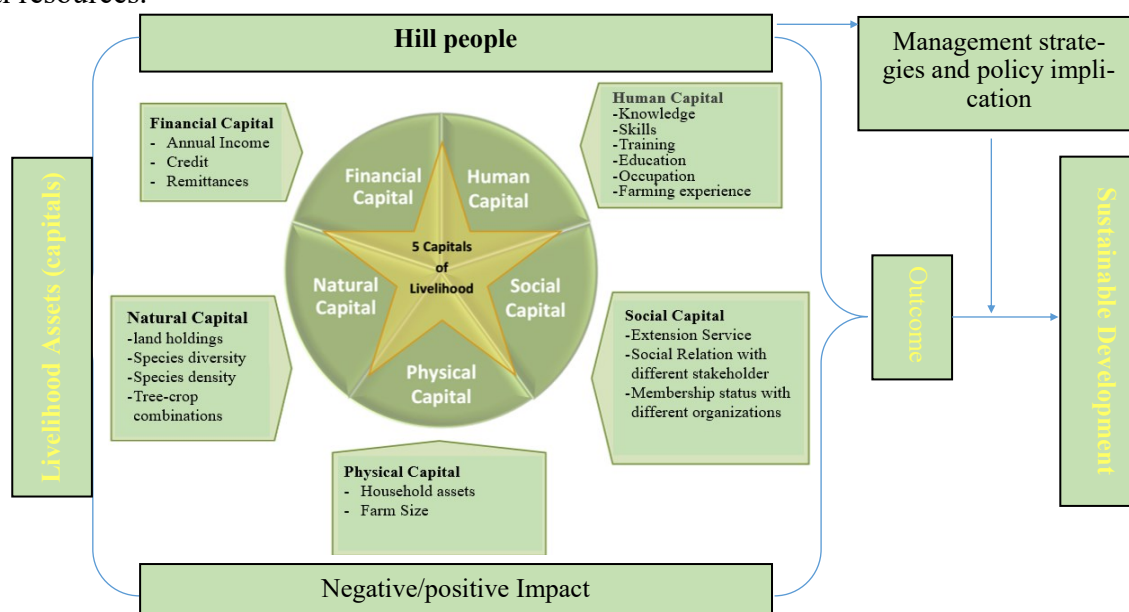


Figure 1: Conceptual framework of the livelihood Development of hill dwellers by Sustainable Livelihood Framework, DFID 1999

qualitative and quantitative data from agroforestry practitioners in the selected areas. A group discussion was also conducted to assess the suggestions for way forward and verify the information obtained.

After the completion of the field survey, data from all the interview schedules were coded, compiled, tabulated and analyzed in accordance with the objectives of the study. Local units of Taka (Tk.) were converted into international standard units of the United States dollar (USD), whenever necessary.

In the hill area homestead agroforestry, cropland agroforestry, and woodlot agroforestry is found (Jewel *et al.* 2019). Among these, ‘agroforestry’ refers to the presence of woody perennial trees in the agricultural field and ‘farming’ means overall agriculture with or without trees. P value was calculated by chi square test between observed and expected counts of each category using MS Excel. The sample area maps are shown below:

RESULTS AND DISCUSSION

Livelihood status of the agroforestry practiced farmers

The primary focus of the study was to determine the livelihood enhancement status of agroforestry farmers through livelihood interventions. This was a dependable variable and measured with five assets of livelihood, namely human, physical, natural, financial,

and social capital, defined as the Capital Asset Framework (CAF). Based on the CAF, formulated for analyzing the livelihood status of hill dwellers in the study area. The overall status of the agroforestry practiced farmers’ livelihood improvement has been discussed and interpreted.

Development of Human Capital

Human capital may be the most important livelihood resource which ensures greater access to food, timber, fodder, and fuelwood and livelihood capital, excluding social capital (Akter *et al.* 2022). It depends on the internal demographic factors of the family, such as age, educational status, occupational status, marital status, gender, family size (Table 1), farm size (Fig. 5), farming experience and skill levels in agricultural activities (Table 2) etc. (Ellis 2000). It also includes training received from extension services (Table 3 and 4) (DFID 2001). This human capital further emphasizes skill, knowledge, and capacity.

Socio-demographic characteristics of farmers

A demographic characteristic of the respondents or any society is important for analyzing its livelihood system (Ahmed *et al.* 2015). It was found from table 1, the respondents’ age groups, educational status, marital status, occupational status, gender status and family size are non-significant (P value > 0.05) and does not important for the adoption of agroforestry. Among them,

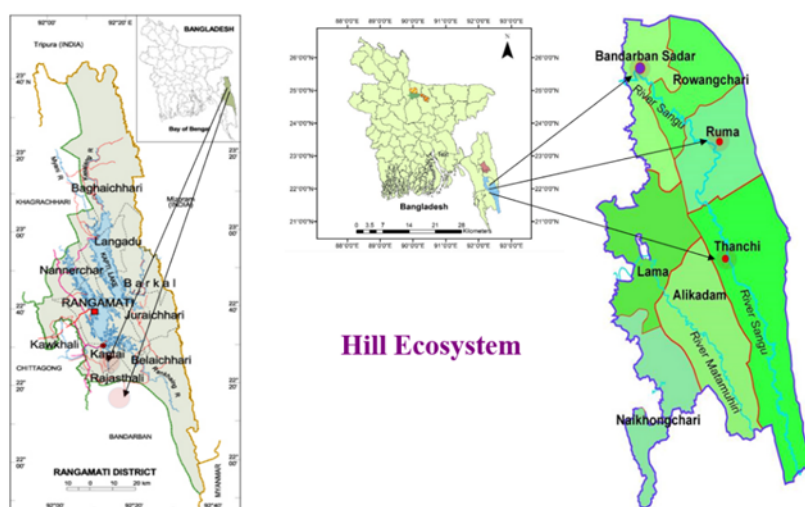


Figure 2: Sample hill areas of Rangamati and Bandarban districts

educational status and occupational status refer to the knowledge and skills of the respondents, respectively. Though Mwase *et al.* (2015) found that age does not affect the adoption of agroforestry, but, Oduniyi (2018), Ndambiri *et al.* (2012), Deressa *et al.* (2008), and Ajuang *et al.* (2016) found that age creates awareness of agroforestry, which may be enough to improve their livelihood through practicing agroforestry. On contrary, Mbwiga (2016) and Irshad *et al.* (2011) indicated that farmers who were willing to practice

agroforestry had higher education levels than those who practiced conventional farming and could change their livelihood easily. Jara-Rojas *et al.* (2020) also support their opinion.

Furthermore, they opined that the development of human capital in the form of skills and knowledge on farming system is accumulated through the education, and the higher educational level of the household head. Which helps the greater chance to make positive decision about practicing agroforestry

Table 1: Distribution of selected hill farmers according to their socio-economic/demographic characteristics (n=100)

Characteristics	Categories	Region (Respondent)				Total (Average)		P value (%)
		Rangamati		Bandarban		No.	%	
		No.	%	No.	%			
Age Groups (Years)	20-30	16	32	18	36	17	34	0.750
	31-40	13	26	16	32	14.5	29	
	41-50	12	24	10	20	11	22	
	> 50	9	18	6	12	7.5	15	
Educational status	Illiterate	23	46	21	42	22	44	0.674
	Up to primary	15	30	15	30	15	30	
	Up to secondary	9	18	10	20	9.5	19	
	Above secondary	3	6	4	8	3.5	7	
Occupational/employment status	Agriculture	30	60	34	68.2	32	64.1	0.875
	Daily labour	5	10.1	5	10.8	5	10.45	
	Business	5	10.7	5	9	5	9.85	
	Service	3	5.2	1	2.7	2	3.95	
	Student	7	14	5	9.3	6	11.65	
Marital status	Married	45	89.7	47	94.7	46	92	0.701
	Unmarried	4	8	2	4.2	3	6	
	Widow	1	2.3	1	1.1	1	2	
Gender status	Male	28	56	27	54	23	55	0.816
	Female	22	44	23	46	28	45	
Family Size	Small (≤ 4)	10	19	12	24	11	19.6	0.305
	Medium (5 to 7)	25	50	31	61	28	58.6	
	Large (>7)	16	31	8	15	12	21.4	

Table 2: Distribution of farmers according to their farm experience

Particulars	Region (% of respondents)		Total (Average)
	Rangamati	Bandarban	
Mean (Years)	20.96	19.48	19.45
St. Dev. (Years)	5.24	6.04	5.68
Categories of farming experience (% of respondents)			
Up to 10	32.4	42.29	37.35
11-15	22.6	16.81	19.71
16-20	26.8	13.69	20.25
> 20	18.2	27.21	22.71

rather than conventional farming (Ahmad *et al.* 2021).

Table 1 presence agriculture (64.1%) is the major livelihood activity, from which the majority of the people earn. Surveyed households in the study areas also earn income from non-farm sources like daily labour, business and service. These activities also play an important role in rural poverty salvation and sustainable rural livelihoods, which has already been discussed by Akter *et al.* (2022), Hanif *et al.* (2018) and Akram *et al.* (2011).

Farming experience

Table 2 represents the average farming experience of the respondents was 19 years. About 37% of farmers had more than 10 years of farming experience. The number of more than 10 years experienced and highest farming experience (more than 20 Years) farmers were highest (42% and 27%) in Bandarban district and lowest in Rangamati district (32% and 18%). Liliane (2020) found farming experience is not statistically significant in improving rural livelihoods.

Training experience

Table 3 showed that the respondents of the study areas received agroforestry, crop/land management, farming system, post-harvest technology and other different types of training. In Rangamati and Banbarban, 87% of the sample respondents received training on

the mentioned topics whereas only 13.00% of the respondents had received no training. Among them, only 8% of respondents received agroforestry related training, which is the lowest percentage of all the topics of training followed by Crop/land Management (29.5%), Farming Systems (17.5%), Post-harvest Technology (17%), and other (15%) types of training. Akter *et al.* (2022) reported human capital had improved significantly due to practicing agroforestry.

Among the innumerable nature of training, only Bangladesh Agricultural Research Institute (BARI) and Bangladesh Forest Research Institute (BFRI), Chattogram, provided agroforestry related training (7%). However, NGOs provide the lowest percentage (1%) of training on agroforestry, which implies that farmers have limited access to agroforestry related training. So, the respondents' knowledge and skills for managing the multiple interactions between trees and crops, which means respondents' knowledge of agroforestry were limited. Akter *et al.* (2022) found training on different aspects enhanced human capital to improve household income.

Impact of training

Training on different agricultural topics impacted the respondents very much. A Chi-squared test was used to determine the effect of participation in training on agroforestry, crop/land management, farming system, post-

Table 3: The average distribution of various training across different disciplines and institutions

Name of the institution	Frequency	Average percentage of all areas	Types of training				
			Percentage of training received				
			Agro-forestry	Crop/land management	Farming System	Post-harvest Technology	Others
None	7	13.00					
BARI/BFRI	8	16.00	7	4	3	1	1
CU	11	22.00	0	5.5	2.5	5	9
DAE	15	30.00	0	12.5	6.5	8	3
NGO/Others	10	19.00	1	7.5	5.5	3	2
Total training	44	87.00	8	29.5	17.5	17	15

harvest technology, and others.

The results of the Chi-squared test showed that there is a positive significant relationship between peoples' participation rates with the crop management training and there is no significant relationship between participation in "farming system and post-harvest technology" training. The results also showed that the p-value of agroforestry and other training is very highly significant (Table 4).

Development of Financial Capital

Table 5 showed that 74 % of respondents borrowed money from the last five years, a range of Tk. 10000 to 60,000 (97.13-582.77 USD) from NGOs and Banks. Among them, those who have practiced agroforestry can improve the financial well-being of families. However, Akter *et al.* (2022) and Nyberg *et al.* (2020) found that farmers who manage agroforestry, are able to financially save more than other farmers.

Aggregate annual earnings are one of the important components for measuring the strength of financial capital. Table 7 shows that the average income from crop selling was

Table 4: Average results of Chi-squared tests in the study areas

Variables	Significance level
Training on Agroforestry	0.0000002
Training on Crop/land management	0.0850093
Training on Farming System	0.2155303
Training on Post-harvest Technology	0.1436509
Others	0.0025937

Table 5: Last five years' borrowing status

Particulars	Region		Total
	Rangamati	Bandarban	
Number	19	18	37
Percentage	38.00	36.00	74
Mean	Tk.	45407.00	59716.45
	USD	441.03	580.02
Range	Tk.	10000-48,000	15000-60,000
	USD	97.13-466.22	145.69-582.77

estimated at Tk. 82,075 (796.13 USD) for Rangamati and Tk. 89,733 (870.41 USD) for Bandarban district. Respondents of Bandarban district occupied the highest amount of earnings from crops than the Respondents of Rangamati. On the other hand, with respect to total annual earnings, Rangamati earned the highest amount (Tk. 824,785.99 or 8000.42 USD) than Bandarban (Tk. 769,500.90 or 7464.16 USD). Yang *et al.* (2019), Rahman *et al.* (2016), and Rahman *et al.* (2012) opined that agroforestry ensures maximum tree production on agricultural land and increases the income of farmers through an increase in Land Equivalent Ratio (LER) (Deb and Dutta, 2022).

In fact, Bandarban hill dwellers are comparatively weak with respect to financial strength than the study area of Rangamati. Other major sources of income are wages and salaries and raising livestock and poultry. Ellis (1998) found that members of a family who worked in urban areas or other places often maintained their strong relationships with family in rural areas by providing cash, especially during emergencies.

Development of Physical Capital

Physical capital considers the households' possession or resources *e.g.* number of rooms in the house, trees, livestock, agricultural equipment, necessary household amenities (Table 8) and farm size (Fig. 5), instead of larger physical capital such as fixed capital, manufacturing equipment, real estate, and inventory *etc.* Among the various physical capital items, almost all respondents had one or two rooms for living. Approximately 60% of household had goats or boar while only 40% had cattle or buffalo. This implies that

[1 Tk.= 0.0097 USD according to 22 September 2022]

hill dwellers had more goats/boar of cattle/buffalo. With respect to household amenities, about 98.5 % of households had a TV and a refrigerator. About 77% of the respondents had mobile phones which might be used to provide extension advisory services due to remoteness in hill areas. Basically, agroforestry improves physical capital both directly and indirectly and builds livelihood resilience to floods and droughts (Quandt *et al.* 2017).

Development of Social Capital

Social capital combines formal organizations

with more informal networks or connections, as well as people's reciprocal and exchange relationships. Figure 3 depicts the status of membership or attachment with various institutions. It was discovered that on average, 22.5% of respondents were attached with various financial and community based organizations. However, in Bandarban, 15% of the respondents reported their attachment status, which expose that the respondents have a lower level of engagement with local social and financial institutions than the Rangamati (30%). NGOs (i.e., Parbat Manab Unnayan O Shahajhakari Sangstha, Muruilla Boidda

Table 7: Annual earnings of respondent households

Yearly family income/earning (Tk. & USD)		Region		Total (Average)
		Rangamati	Bandarban	
Earning from crop selling	Tk.	82,075.12	89,733.33	85904.23
	USD	796.13	870.41	833.27
Earning from tree and tree product	Tk.	65,733.33	52,075.12	58904.23
	USD	637.61	505.13	571.37
Earning from livestock and poultry	Tk.	31,346.75	31,356.15	31351.45
	USD	304.06	304.15	304.11
Earning from fisheries	Tk.	21,500.00	10,356.00	15928.00
	USD	208.55	100.45	154.50
Earning from wages and salaries	Tk.	78,318.29	83,278.90	80798.60
	USD	759.69	807.81	783.75
Earning from small business	Tk.	45,812.50	52,701.40	49256.95
	USD	444.38	511.20	477.79
Govt. support or grants	Tk.	500,000.00	450,000.00	475000.00
	USD	4850.00	4365.00	4607.50
All average	Tk.	824,785.99	769,500.90	797143.45
	USD	8000.42	7464.16	7732.29

[1 Tk.=0.0097 USD according to 22 September 2022]

Table 8: Possession of household assets

Asset	Total			Rangamati	Bandarban
	Average No./ quantity	Average Area (ha)	Percentage of people obtain	Average No./ quantity	Average No./ quantity
House/room (No.)	2.10	0.0096	89.7	2.3	1.9
Tree (No.)	42.55	0.0874	82	49.2	35.9
Cattle/buffalo (No.)	3.00		30.30	2.6	3.4
Goat/Boar (No.)	5.28		60.28	5.49	5.06
Chicken/duck	14.39		68.95	15.93	12.85
Thresher/dryer	0.40		8.63	0.2	0.6
TV/fridge	6.15		98.5	7.13	5.16
Cell phone	71.00		77.02	46	96
High-value vehicles (Motorbike)	0.76		6.1	1.1	0.41
Others	1.00		6.31	1	1

Samiti, Vadvadi, Balipara Nari Kallyan Samity, Tagindong, Gram Unnayan Sangathan, and Grameen Bank, etc.), School communities, Kiang, Research Institutions were reported to have greater connectivity, as showed in figures 4a and 4b. Overall, institutional linkages at this stage were found to be limited among study households. This could be an important indicator to assess the impact of the respondent’s livelihood. Ahmad *et al.* (2021) found that agroforestry helped to improve social interactions among farmers by involving the groups and their group meetings. The overall impact was to improve trust among them.

**Development of Natural Capital
Distribution of farmers according to farm size**

Natural capital is the term used for the natural stocks from which resources flow and from which services useful for livelihoods, are derived (DFID 2001). According to Abedin and Quddus (1988), and Alam and Masum (2005), the, sample households’ land holdings/ownership status are classified into three categories: small (≤ 2.4 acres), medium (≥ 2.5 to 7.4 acres), and large (≥ 7.5 acres) (BBS 2017). Productive farmland is the core natural capital upon which farmers’ livelihoods are built.

Institutional attachment

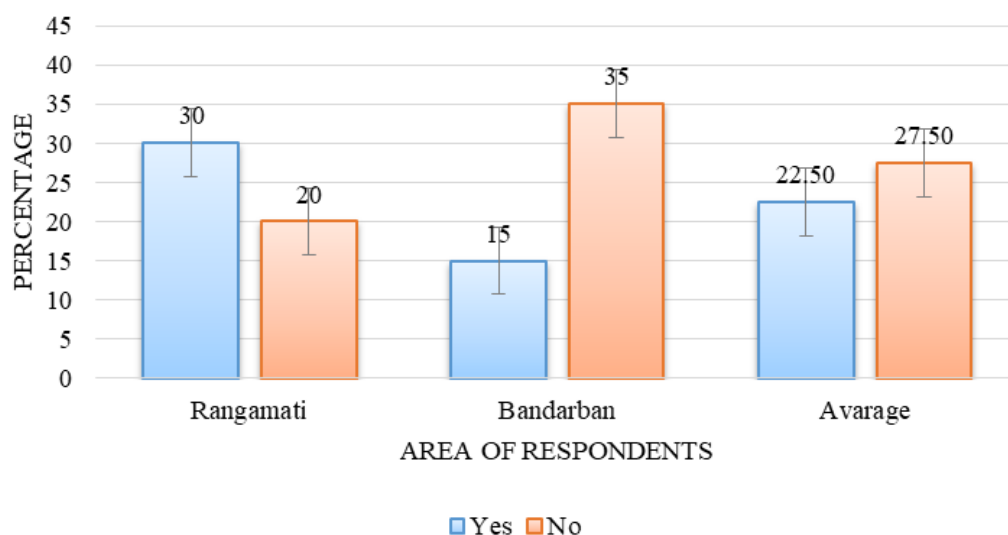


Figure 3: Membership/attachment status of the respondents

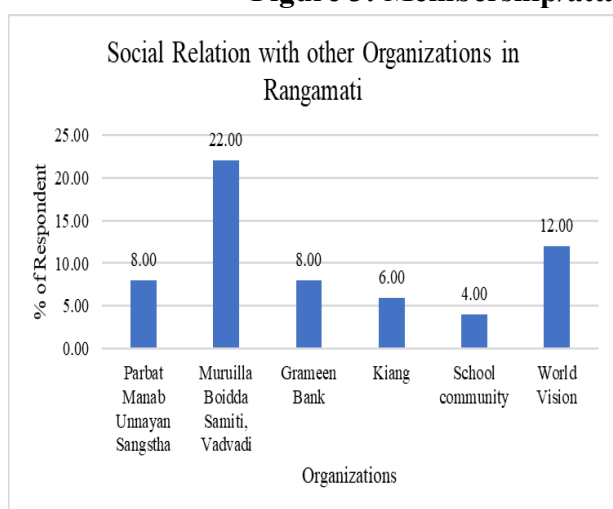


Figure 4a: Social relationship with different organizations in Rangamati

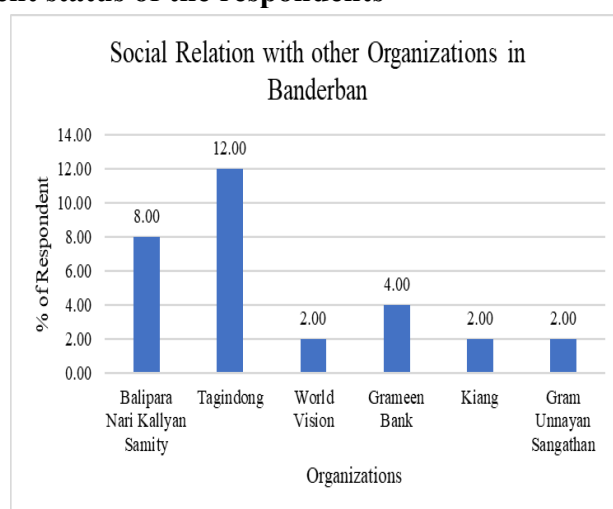


Figure 4b: Social relationship with different organizations in Bandarban

Landholding status is one of the indicators of the economic condition of the respondents (Ahmad *et al.* 2021). Saha *et al.* (2018) found a significant association between farm size and the adoption of agroforestry practices.

Figure 5 apparent that small farmers (78%) predominate in the hilly areas of the two sample districts. There are a few medium-sized farmers (16%) and only a few large farmers (6%) found across the total sample in all two districts. Liliane (2020) found that farm size is highly significant for rural farmers' livelihood improvement.

Table 9 showed that the average land holding of the sample farmers was 2.9 acres (290 decimal), where homestead agroforestry area was 0.15 acre (15 decimal), agroforestry in agricultural land was 0.585 acres (58.5 decimal), and

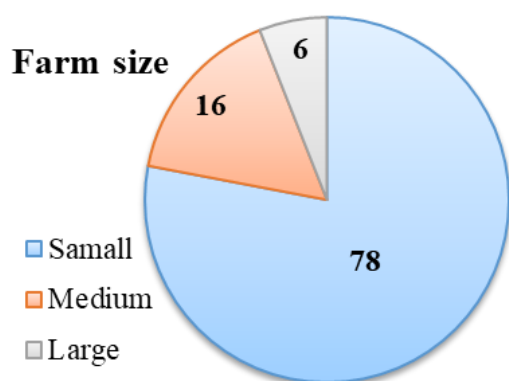


Figure 5: Farm size distribution of sample farmers

agroforestry in forest garden was 1.57 acre (157 decimal). Although, Ahmed (2001) highlighted that agroforestry farmers in Gazipur, Bangladesh, have more grain and pulse crops and fewer numbers of fruit crops in their farmland along the boundary.

Table 9 also stated that agroforestry farmers own more land (2.585 acres or 258 decimal) than leased in (1.47 acres or 147 decimal) and leased out (1.155 acres or 115 decimal). Thus, research has shown that large landholders are more interested than small landholders. Similar searches were provided by Amsalu and Graf 2007; Dhakal *et al.* 2015; Beyene *et al.* 2019; Ahmad *et al.* 2021.

Asset-wise livelihood improvement status of agroforestry farmers

Asset-wise livelihood improvement of status was the highest in social capital (68.85), followed by human (66.58), natural (66.52) and physical capital (66.47). It was found that livelihood enhancement concerning financial capital was the lowest (57.61) among the five capitals of livelihood assets (Fig. 6).

It was found to be from the fig. 6. that livelihood assets are interconnected, giving farmers comparable access to physical and natural capital and comparatively greater access to social capital, which could develop their human capital, i.e., skills and knowledge

Table 9: Distribution of land holdings of sample farmers

Particulars	Region		All region (Average)
	Rangamati	Bandarban	
Homestead and cultivable average land in acres (Decimal)			
Own	2.68 (268)	2.49 (249)	2.585 (258)
Leased in	1.03 (103)	1.91 (191)	1.47 (147)
Leased out	1.26 (126)	1.05 (105)	1.155 (115)
Total land holding (Own + leased in - leased out)	2.45 (245)	3.35 (335)	2.9 (290)
Average land ownership in acres (Decimal)			
Male own	2.11 (211)	1.29 (129)	1.7 (170)
Female own	0.57 (57)	1.2 (120)	0.558 (88)
Average land distribution in different sectors in acres (Decimal)			
Homestead area	0.11 (11)	0.19 (19)	0.15 (15)
Agricultural activities	0.17 (17)	1 (100)	0.585 (58.5)
Forest Garden	1.07 (107)	2.07 (207)	1.57 (157)
Others	1.1 (110)	0.09 (9)	0.595 (59.5)

acquired through sustainable farming. Similarly, farmers can improve their financial capital by maintaining these capitals (Akter *et al.* 2022).

Problems faced by agroforestry farmers

Table 10 identified the four types of problems *e.g.* tree-crop competition-related problems, environmental problems, socio-economic problems; and other problems. The most

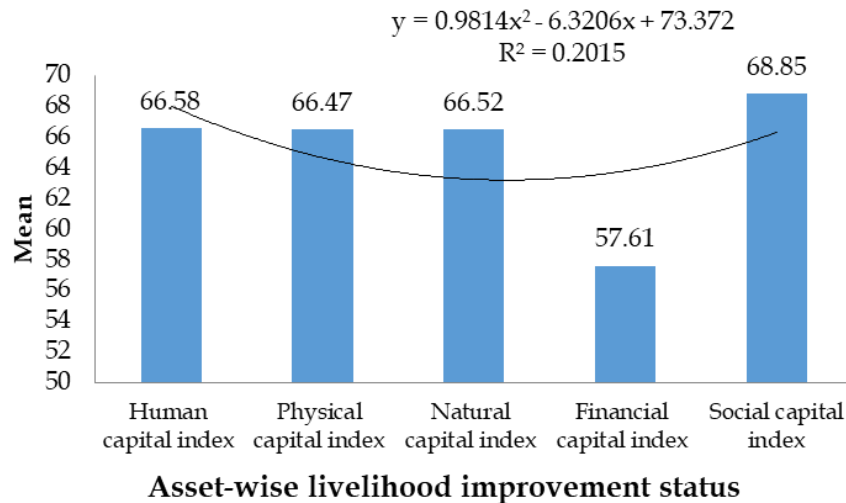


Figure 6: Livelihood improvement status of regarding different assets

Table 10: Problems faced by agroforestry practiced farmers

Sl.No.	Types of Problems	% respondents	Rank
A	Tree-crop competition-related problems		
1	Competition for light	80	4 th
2	Competition for nutrient	60	6 th
3	Competition for space	90	1 st
4	Competition for moisture	20	9 th
B	Environmental problems		
5	Shelter of insect and pest	40	7 th
6	Allelopathic effect	6	13 th
7	Damaging land by quick-growing roots	4	14 th
8	Falling of trees on crops	8	12 th
9	Poor soil fertility and soil erosion	10	11 th
C	Socio-economic problems		
10	Lack of hired labour	90	1 st
11	Unavailability of land	30	8 th
12	Low production than mono-crop	70	5 th
13	Problems of thieves	30	8 th
D	Other problems		
14	Lack of marketing facilities	89	2 nd
15	Lack of adequate knowledge, information, and advisory services	87	3 rd
16	Unavailability of quality seedlings	60	6 th
17	Lack of fertilizer, pesticide and fungicide	60	6 th
18	Lack of Irrigation	20	9 th
19	Excessive post-harvest losses	40	7 th
20	Social and cultural Barriers	13	10 th

important problems identified by the respondents' were space (tree-crop competition-related problems) and labour problems (socio-economic problems), which were ranked first followed by a lack of marketing facilities, insufficient knowledge, information, and advisory services, competition for light, and lower production than mono-crop. Only 4% of farmers thought damaging land by quickly growing roots (an environmental problem) was the lowest-ranked problem in the selected study areas. Ibrahim *et al.* (2019), and Jewel and Amin (2017) were identified the similar problems which is closely related with the tree-crop competitions, environmental, socio-economic and marketing, advisory related problems. Farmers mentioned that if proper care is taken of these problems, the adoption level will increase significantly.

Farmers benefited from agroforestry

Table 11 recognizes the three types of benefits, *e.g.*, tree-crop-related benefits, environmental benefits, and socio-economic benefits. The benefits identified by the respondents were: higher income, opined 95% of the respondents; job opportunities

throughout the year, opined 90% of the respondents; and fulfilling fuelwood demand, opined 89% of the respondents. They ranked 1st, 2nd and 3rd, respectively, as benefiting from agroforestry in terms of socio-economic benefits.

It was found from tables 10 and 11 that moderate socio-economical problems and high socio-economical benefits are positively affected by the livelihood improvement of agroforestry farmers. Roy *et al.* (2018) opined that livelihood improvement through poverty eradication, education, health, training on income-generating activities (IGAs), motivation, and awareness building are the gender issues to be solved, which is indicated by the socio-economical problem.

The way forward and suggestions

During the group discussion, the respondents were suggested the following solutions reduce the constraints: encouraging and increasing investments in educating farmers to change their mindsets, including the process of developing market systems for agroforestry products, incorporating traditional knowledge into local-level planning. The country is rich

Table 11: Benefits enjoyed by agroforestry farmers

Sl.No.	Types of Benefits	% respondents	Rank
A Tree-crop related benefits			
1	Increase the no. of tree, crops and livestock	58	7 th
2	Use of domestic waste for soil fertility	46	10 th
3	Maximum utilization of land	87	4 th
4	Increase crop security	20	16 th
B Environmental benefits			
5	Soil fertility increase	55	8 th
6	Checked soil erosion	48	9 th
7	Soil moisture holding capacity increased	36	13 th
8	Organic matter added	73	5 th
9	Protect from heavy wind flow	37	12 th
C Socio-economic benefits			
10	Job opportunity throughout the year	90	2 nd
11	Higher income	95	1 st
12	Fulfill fuelwood demand	89	3 rd
13	Increase community mobility	33	14 th
14	Increased food security	65	6 th
15	Increase agricultural knowledge	41	11 th
16	Social entity increased	22	15 th

in agro-realistic diversity. All agroforestry systems and practices are not appropriate everywhere. The current state of scientific knowledge provides little guidance on which agroforestry systems and practices work in agroecosystems and social contexts. As a result, policymakers and other stakeholders should be aware and take initiatives to institutionalize research activities, strengthen collaboration between research and extension, and increase carbon sinks in order to improve sustainable agroforestry systems.

CONCLUSIONS

Hill dwellers play an important role in agriculture and the forest sector, despite the fact that respondents in the study areas were at a disadvantage in terms of transportation and communication facilities, agricultural equipment ownership, access to extension advisory services, and financial strength. The farmers indicated a mixed impact on five types of livelihood capital, namely human, physical, natural, financial and social. According to the results, a majority of the farmers were not educated but were mostly involved in agriculture, while both men and women were responsible for earning money by taking care of the household chores. Although there is potential land in the study area for agroforestry practices, the participants are inadequate in their capacities (small farm size, low annual income, higher number of non-working females, unskilled persons) to practice agroforestry at a larger scale. All these observations have been combined with the socio-economic and agricultural characteristics of the hill people, which definitely helps to determine that the adoption of agroforestry practices increases livelihood status in the study areas.

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AUTHOR CONTRIBUTION

The corresponding author collected data and

prepared the article. The rest of the authors reviewed and finalized the article.

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