
Economics of homestead forestry and their management activities at Fatickchari Upazila of Chittagong district, Bangladesh

Muhammad Abul Foysal¹, Md. Lokman Hossain^{2, *}, Ashik Rubaiyat³, Md. Byzid Hasan³

¹Assistant Fund Raising Officer, Shushilan, Dhaka, Bangladesh

²Project Coordinator, Building a Disaster Resilient Bangladesh, DIPECHO-VII, USS & AAB, Khulna, Bangladesh

³Institute of Forestry and Environmental Sciences, University of Chittagong, Chittagong-4331, Bangladesh

Email address:

mafoysal1983@gmail.com (M. A. Foysal), lokmanbbd@gmail.com (Md. L. Hossain), ashik108@gmail.com (A. Rubaiyat), tmdbyzidhasan@yahoo.com (Md. B. Hasan)

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Abstract: An exploratory study was carried out to identify the homestead tree resources, their utilization pattern, economic return of major fruit and timber tree species, their management activities for sustainable production as well as constraints of homestead plantation in Fatickchari Upazila of Chittagong district, Bangladesh over the period of six months by using multistage random sampling design of 96 households categorized into marginal (>0.02-0.08 ha), small (0.08-0.14 ha), medium (>0.14-0.20 ha) and large (>0.20 ha) based on homestead areas. Sample households were selected randomly taking three from each category in each ward. Total number of tree species was increased with the increase in homestead areas. In case of socio-economic aspects of the respondents, it was found that tree variety (%) has a gradual increasing trend with increase of education level. However, relative tree density (%) was found to have increasing trend with education up to higher secondary level and after that there was a slight decreasing trend. People involve in agriculture have got higher tree density (31%) compared to other occupations such as; service (28%), business (24%) and daily labour (17%). The investment analysis revealed that longer time investment on fruit and timber tree species is profitable. Lack of technical knowledge of growing trees, unavailability of space and good quality seed/seedlings were the major constraints of homestead forestry production. This study may be useful baseline information to forest policy makers in Bangladesh.

Keywords: Diversity, Forestry, Homestead, Management, Silviculture, Species

1. Introduction

Land is the basic resources of human society. Bangladesh is an over populated and land hungry country having about 14.4 million hectares of land with population of 147.1 millions. Because of the rapid growth of population and indiscriminate destruction of forest cover, it is difficult to meet the country's huge demand for timber, fuel, food and fodder and maintaining ecological balance. In such a situation home garden represents a land use system involving deliberate management of multipurpose trees and shrubs in close association with seasonal vegetables [1]. Homestead agroforestry plays a vital role in providing fire wood, fodder, fruit and timber. These practices are appropriate for poor farmer as they can earn immediate benefit from agri-crops while waiting for long term benefits

from trees.

Homestead forestry is an age old practice and an integral part of the traditional farming system of Bangladesh. It is the form of agroforestry where different kinds of crops, including vegetables and trees are grown in mixture with or without livestock. Homestead forests are the privately owned trees around homestead in the rural areas. Resources are the means for satisfying wants both individual wants and social objectives. Resources embrace a vast variety of commodities, biotic and abiotic, tangible and intangible and in combinations.

Homestead forestry, popularly known as home garden, is as important component of rural economy in the tropical region of the world as well as in Bangladesh. In a typical home garden a number of crops including trees are grown with livestock, poultry or fish production, mainly for the

purpose of satisfying the farmer's basic needs [2]. A homestead is used as dwelling and as well as a production unit for plants, animals, fish under integrated farming system in which continuous interaction takes place among men, trees, livestock, soil, water etc.

The combination of different cultivated plant allows permanent production throughout the year. The flow of small quantities of various products helps the farmers in maintaining economic and nutritional stability. Village homestead forest resources are very important in the socioeconomic of many countries in the south Asian countries. In Bangladesh, homestead forest occupy about 0.27 million ha. It is believed that as much as 80% supply of the forest products come from this source, though it covers only 2% of total forest area. Homestead forest or forest groves are mostly on privately owned lands covered with trees and bamboo corps of varying quality and density. The traditional Bangladeshi homesteads are arranged in multistoried fashion and biodiversity is so rich that they are more efficient than rich tropical rain forests in terms of their production, protection amenity and values [3]. Species composition in the home garden of Bangladesh is ranging from small herbs to big trees.

Of the total land mass of Bangladesh, 63.74% are occupied by agricultural land, 6.94% un class state forest, 0.79% tea gardens, 2.46% uncultivated lands, 9.21% national forest, 7.26% homestead land and 9.6% marshy land respectively [4]. Bangladesh possesses forestlands of approximately 2.41 million ha. Out of this 1.37 million ha (9.5%) is managed by forest department and 0.74 million ha (5%) under the jurisdiction of District Administration.

About 85% people of Bangladesh live in the rural areas and their homegarden possess more or less some agroforestry component. According to the classification agroforestry system based on the nature and type of components, most home gardens are agrosilvopastoral systems consisting of herbaceous crops, woody perennials and animals. In Bangladesh, homestead agroforestry plays a vital in providing fuel wood, fodder, fruit and timber. It is estimated that about 61-70% of saw logs and 90% of fuel wood and bamboos come from homestead forests. Most of the native fruits, country vegetable, fuel wood and timber come from homestead home yard and marginal lands attached to or nearby homesteads. Through homestead agroforestry the production of various types of fruits, vegetables, spices, fodder, forage, fuel wood and timber can be increased considerably [5].

A country should have at least 25% of the total area under forest for maintaining ecological balance [6]. Once covered by dense forests, Bangladesh is now almost devoid of forested land, except in a few selected areas of the country [7]. Although the Forest Department presently considers 14.6% of the total land area of Bangladesh as forested, in reality, only about 6-8% of the total land area of Bangladesh merits the term 'forested' [7, 8]. Despite the presence of a large government Forest Department dedicated to protecting and managing the forests, forest

cover in Bangladesh has been shrinking rapidly both in terms of area and volume. Massive degradation and depletion of natural forest resources create the difficult challenge of balancing production and consumption of rural fuel energy [9]. Serious imbalance has already been created in the ecosystem, causing a number of meteorological and health hazards. Agroforestry is an important tool to solve the problems of food, fuel, fodder, soil fertility and ecology. Well planned and well managed agro forestry can play a great role in improving homestead production in Bangladesh. Due to the traditional management practices low levels of inputs and technical knowledge, productivity from these sources is not being fully realized.

Fatickchari upazila is to the north of Chittagong city about forty-eight kilometers away from the city. Fatickchari upazila consists of two major topographic regions, viz. a. Northern and Eastern Hills and b. Chittagong flood prone areas. Peoples living in this upazila are very poor and agriculture is the main occupation. Socio-economic aspects of this area were never studied in relation to tree management practices in the homestead area. Homestead forestry has been developed in an unplanned way and farmers planted a number of fruit and timber trees in the homestead areas. Coconut, Mango, Betel nut and Raintree are commonly grown trees. The Forest department planted trees on road side. Systematic information about species composition, homestead utilization pattern, tree variety and tree density in the homestead area in relation to increasing education level of the local people, relative importance of homestead trees, relative profitability of homestead trees, cropping pattern and silvicultural practices followed by farmers, knowledge about NTFPs and medicinal plants are major constraints of homestead plantation. Therefore, it is necessary to evaluate economic benefit from homestead plantation and their management activities at the Fatickchari upazila.

This study has been carried out to identify the plant diversity, homestead utilization pattern, relative importance of homestead trees, and relative profitability of homestead trees through investment analysis and to study their management for sustainable production as well as constraints of homestead plantation at Fatickchari upazila of Chittagong District.

2. Materials and Methods

2.1. Description of Data Source

The study was conducted in the Fatickchari Upazila of Chittagong District, located between 22^o41' North latitude and 91^o48' East longitudes, with an area of 773.55 km². The two major topographic regions of Fatickchari are Northern and Eastern Hills which consists of High and Low Hills; and Chittagong Flood Plain Prone Areas which consists of Valleys and Alluvial Deposition of Halda River. The study area topography is generally flat with a coastal island in the south. A tropical moist climate prevails with

an average temperature of 7^oC to 39^oC and average annual rainfall of 2730 mm (Information from Department of Environment, Chittagong), which is unevenly distributed and often unreliable. The Fatickchari Upazila consists of 20 Union Parishads, 102 Mauzas, and 199 villages with the population of 452645 [10]. It has a total cultivated land of 33994.33 hectares (ha) and fellow of 5167.95 ha, whereas, per capita land amount is about 0.19ha. Single crop 57.80%, double crop 30.22% and treble crop land 11.98% in this Upazila. Among the peasants 46.54% are landowners and 53.46% are landless. The main sources of surface water in Fatickchari Upazila are the Halda River, Sarta and Dhurung canal, about 557 ponds and 50-60 hilly stream channels. Males constitute 50.10% of the population, and females 49.90%; Muslim 85% and the remaining are the followers of Hinduism and Christianity [10]. The annual population growth rate is about 2.35%. Average literacy is about 32% of which male 37.6% and female 26.4%. There are almost 79 km road is made with brick and stone and almost 364 km road is muddy. Electricity has been connected with about 3580 households of 28 villages. Main occupations of this Upazila included agriculture 27.23%, agriculture laborer 14.87%, wage laborer 4.37%, industry 1.94%, commerce 13.88%, transport 1.63%, service 18.81%, house renting out 1.66%, and others 15.61% [10]. Most of the female members of the household are engaged with homesteads forest based rural industries such as bamboo work, canes work, potteries, blacksmith, handloom, wood work, brass, jute, cotton and other. Besides, there are 17 tea gardens and 3 rubber gardens in this Upazila.

2.2. Data Collection

Among twenty (20) unions of the Fatickchari Upazila, 4 unions (Roshangiry, Nanupur, Dalautpur & Sundarpur) were selected randomly for the study. Two wards from each union were then selected randomly. Sample homesteads were then selected by categorizing them into marginal (>0.02-0.08ha), small (0.08-0.14ha), medium (>0.14-0.20ha) and large (>0.20ha) based on homestead areas. Three homesteads from each category in each ward were then selected randomly. Thus a total of 96 homesteads were selected randomly from 4 unions. The selected homestead owners were then interviewed with a pre structured questionnaire to collect data or information related to socio-economic conditions, homestead resources, their utilization pattern and management activities.

2.3. Income from Homestead Tree Species

To calculate homestead income, the value of harvested fruits from the home garden (either consumed or sold), value of twigs, branches, leaves, fuel wood, bamboo, trees used for household cooking or sold to market, NTFPs and vegetables were counted. Information on products, sale, income and expenditure were based on recalling from household's last year input used and output obtained and expenditure.

2.4. Investment Analysis

In order to evaluate the profitability and productivity of the homestead trees (horticulture and timber trees) investment analysis were carried out considering benefit of the present and future product with their present value and costs up to present year of specific trees. For this purpose Total cost (TC), Total revenue (TR) & Net benefit (NB) BDT/tree were analyzed.

$$\text{Net benefit} = \text{Total revenue} - \text{Total cost}$$

In investment analysis total cost of fruit and timber trees included seed/sapling, manure/fertilizer/pesticides, planting material and labor cost on the basis of per tree. All fruit and timber trees were estimated for 25 years rotation, whereas, guava and lemon were estimated for 15 years rotation and banana for one year. Secondary and primary information were used to estimate the fruit and timber yield of different species. The fuel wood yield was estimated on the basis of farmers' practices on branch/leaf pruning in different species.

2.5. Species Frequency

The contribution made by each species in a home garden can be expressed as a percentage of the total number of species, which is called frequency. Since frequency often reflects the patterns of distribution of individuals as well as their density. It also expresses information about both patterns and abundance. Species and individuals can be grouped into growth form classes on the basis of their similarities in structure and growth, which displays an obvious relationship to important environmental factors. Thus, frequency can be expressed by using the following formula [11].

$$\text{Frequency} = \frac{\text{Total no of samples in which the species occurs}}{\text{Total no. of sample studied}} \times 100$$

2.6. Distribution of Number of Trees by Diameter Classes

Distribution by diameter classes is a common method of grouping trees and many inventory data are available for trees already classified into diameter classes. Diameter at breast height (DBH) is the easiest tree measurement in spite of the difficulty caused by the presence of buttresses. Measurement units, class intervals and lower limits for diameter differ significantly from one species to another.

2.7. Density

The numerical strength of a species in relation to a definite unit space is called its density. Density refers to the number of individuals of a particular species per unit area. Thus density can be found by using the following formula [11].

$$\text{Density of a species per unit area} = \frac{\text{Total number of individual of a species in all the sample plots}}{\text{Total No of sample plots studied}}$$

2.8. Species Dominance

In a given uniform climatic, topographic and edaphic condition it is considered that species dominance is the most important factor in determining the character of the community. It cannot be said that the most frequent species is the dominant for where there is a great difference in the life form of species; the largest species is often dominant. So the individual of a species having greater Relative Importance Value (RIV) are dominant to individuals of any other species.

$$\text{RIV} = \text{Relative frequency} + \text{Relative density} + \text{Relative cover}$$

Where, Relative frequency of a species

$$A = \frac{\text{Percentage frequency of species A}}{\text{Sum of all species percentage frequencies}} \times 100$$

$$\text{Relative density of species A} = \frac{\text{Density of species A}}{\text{Density of all species}} \times 100$$

$$\text{Relative cover of species A} = \frac{\text{Crown area of species A}}{\text{Crown area of all species}} \times 100$$

2.9. Crown Cover

Cover is defined as the proportion of ground occupied by perpendicular projection on to it of the aerial parts of individuals of the species under consideration, and it is usually expressed as a percentage. Because of the over layering of different species the total cover of an area may exceed 100 percent in the case of home garden and it may reach several hundred percent. Crown cover is calculated according to the formula of an ellipse as follows:

$$C = 0.25 \times D1 \times D2 \times \pi$$

Where D1 = Largest crown diameter

D2 = Diameter perpendicular to D1

2.10. Horizontal Structure

Typical home garden usually represent the appearance of a crowded haphazard assemblage of trees, shrubs, herbs, climbers and creeping plants. Most farmers try to optimize their home gardens by planting as many crops as they can in the limited space available and in the physical constraints of their home environment. The horizontal structure is assessed in terms of species locations within the home gardens. Species locations within the home gardens are assessed in relation to distance from the living quarters. Species locations in the home gardens could be considered with respect to major locations. Only the border only, the interior part only and both border and interior parts.

2.11. Vertical Structure

It expresses the home garden with many life forms varying from those creeping on the ground such as pumpkins to tall trees of 10m or more e.g. the coconut palm.

These create the forest like multistoried canopy structure of many home gardens. On a more local scale a structural approach can be used to simplify the organization of complex vegetation types the vertical strata in the basis of specific height classes.

3. Results and Discussion

3.1. Socio-Economic Aspects of the Respondents

The study has been conducted to find out the present homestead management practices with respect to different socioeconomic condition of the respondent households. An attempt has been made to find out the relationship between different socio-economic characteristics and tree management practices. For this study mainly three factors such as educational status, occupation and family income of the respondents were considered.

3.1.1. Educational Status of the Respondents

Education is one of the basic needs of human being because, it creates consciousness among people about their household management. It may also increase awareness to plant and management of more trees in their homesteads. In the study area, it was found that most of the respondents (84%) were literate and the rest (16%) were illiterate (Table 1). However, among literate group most of them (57%) are of primary or secondary level educated. Figure 1 depicts the relationship between education level and tree management practices in the homestead measured in terms of tree variety (%) and relative tree density (%) present in the homestead. It was found that tree variety (%) has a gradual increasing trend with increase of education level. This suggests that as people are more educated they are willing to plant more variety of trees based on their necessity. On the other hand, relative tree density (%) was also found to have increasing trend with education up to higher secondary level and after that there is a slight decreasing trend. This might be due to the fact that higher educated people do not usually spend more time in the homestead to increase the productivity and income from the homesteads rather they plant more varieties of trees for their own consumption and satisfaction.

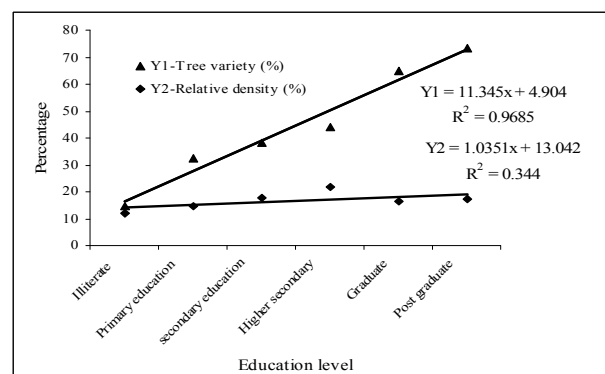


Figure 1: Relationship between Education Level and Tree Management Practices

Table 1: Educational Status of the Respondents and Tree Management Practices

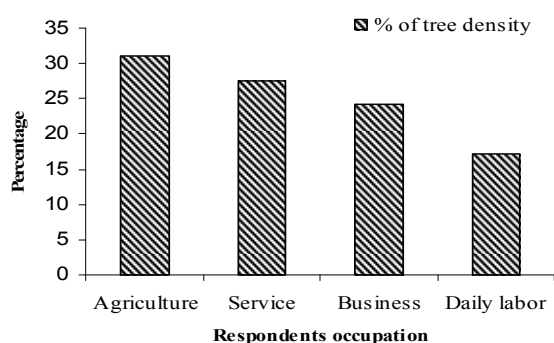
Education label	Respondents (%)	Tree variety (%)	Relative density (%)
Illiterate	15.63	14.71	11.88
Primary education	36.46	32.35	14.85
secondary education	20.83	38.24	17.64
Higher secondary	13.54	44.12	21.85
Graduate	7.29	64.71	16.44
Post graduate	6.25	73.53	17.33
Total	100.00		100.00

3.1.2. Occupation of the Respondents

Occupation leads the life of human being. From the study, it was found that agriculture was the primary occupation for most of the respondents (65%) followed by service (20%), business (10%) and daily labor (5%). Only 55% of the respondents have secondary occupation, which include business (30%), agriculture (10%), service (5%) and labor (10%) (Table 2). Occupation of the respondents shows differences in tree density (%). It was seen that people who are engaged in agriculture have got higher tree density (31%) compared to other occupations such as service (28%), business (24%) and daily labor (17%) (Table 2 and Figure 2). This might be due to the fact that agricultural people can spend more time to their homesteads and tree management practices as well.

Table 2: Respondents' Occupation and Tree Density in the Homesteads

Occupation	Primary (%)	Secondary (%)	Average No. of tree species	Tree density (%)
Agriculture	65	10	46.77	31.01
Service	20	5	41.57	27.56
Business	10	30	36.50	24.20
Daily labor	5	10	26.00	17.23
Total	100			100.00

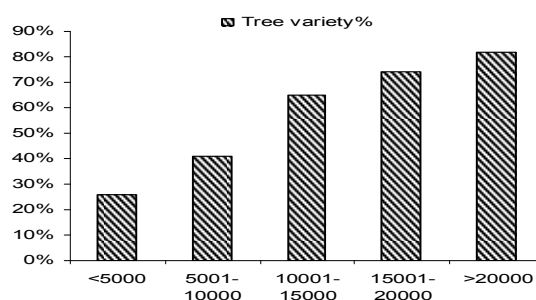
**Figure 2:** Relationship between Respondents' Occupation and Tree Density

3.1.3. Family Income

Family income of households determines their status in the society. It changes their life style and introduces modern life of a family. Results of the survey suggests that majority of the households (54%) have family income of BDT 5000-15000 (Table 3). From the study, it was found that with the increasing of the family income tree variety in the homestead forest also increase. People who earn more money they plant different varieties of tree species in their homestead for increasing the beauty of the homestead and fulfilling their household demand. Figure 3 shows that with the increasing of the family income from BDT 5000 to BDT >20000 tree varieties in their homestead also increased.

Table 3: Family Income of the Respondents and Tree Variety Present in Their Homesteads

Monthly (BDT) income	Respondents (%)	Tree variety (%)
<5000	16	26
5001-10000	31	41
10001-15000	23	65
15001-20000	17	74
>20000	14	82
Total	100	

**Figure 3:** Relationship between Family Income of the Respondents and Tree Variety (%)

3.2. Homestead Utilization Pattern

The homestead utilization pattern in different farm categories is presented in Table 4. The average homestead size was found 0.19 hectare with minimum size of 0.05 hectare for the marginal and maximum size 0.41 hectare for large farmers. Large households were observed to have homestead area much greater than the medium, small and marginal households during the study period. Among the different uses pond occupied the largest space 0.08 hectare of the homesteads followed by housing (0.05 hectare) and vegetation (0.03 hectare) consisting of trees and vegetable garden. Areas under vegetation, yard and cattle shed as well as housing increased with the increase in homestead size (Table 4).

Table 4: Homestead Utilization Pattern in Different Farm Categories at Fatickchari Upzilla

Household Category	Homestead Size (ha)	Homestead area under different uses(hectare)					
		Housing	Cattle shed	Pond	Yard	Vegetation	Other/fellow
Marginal	0.05	0.2 (42%)	0.001 (8%)	0.01 (11%)	0.01 (23%)	0.01 (16%)	-
Small	0.13	0.03 (26%)	0.01 (4%)	0.05 (39%)	0.03 (25%)	0.01 (6%)	-
Medium	0.19	0.06 (33%)	0.01 (4%)	0.08 (39%)	0.02 (8%)	0.03 (13%)	0.01 (3%)
Large	0.41	0.10 (24%)	0.01 (3%)	0.19 (48%)	0.03 (8%)	0.06 (16%)	0.01 (1%)
All size	0.19	0.05 (25%)	0.01 (3%)	0.08 (42%)	0.02 (12%)	0.03 (14%)	0.01 (4%)

Table 5: Major Tree Species Found in the Homesteads of Fatickchari Upazila

Sl. No	Species Name	Number of tree species per household					% household
		Large	Medium	Small	Marginal	All sizes	
Horticultural species		55.20	42.12	22.90	15.70	34.00	33.68
1	Mango	5.75	5.21	4.58	4.00	4.89	98.96
2	Black Berry	1.46	0.92	0.08	0.25	0.68	14.58
3	Jackfruit	3.63	2.50	1.04	0.42	1.90	36.45
4	Indian Jujube	0.88	0.79	0.63	0.33	0.66	32.29
5	Coconut	10.10	9.29	5.63	4.38	7.35	97.92
6	Guava	0.79	0.33	0.08	0.13	0.33	12.50
7	Litchi	1.17	0.91	0.5	0.29	0.72	42.71
8	Olive	0.83	0.37	0.13	0.00	0.33	16.67
9	River Ebony	0.38	0.04	0.29	0.00	0.18	11.46
10	Indian Goose Berry	0.58	0.54	0.33	0.21	0.42	32.29
11	Betel nut	24.5	17.71	8.25	5.17	13.9	97.92
12	Custard Apple	0.38	0.33	0.04	0.08	0.21	16.67
13	Pomegranate	0.46	0.25	0.17	0.00	0.22	17.71
14	Lemon	1.04	0.37	0.08	0.04	0.39	18.75
15	Papaya	0.88	0.83	0.67	0.38	0.69	30.21
16	Banana	1.88	1.33	0.29	0.00	0.88	14.58
17	Bilombi	0.25	0.21	0.13	0.00	0.15	9.37
18	Grape Fruit	0.21	0.16	0.00	0.00	0.09	5.21
Timber species		19.4	11.75	4.58	1.92	9.42	19.01
19	Rain tree	2.21	2.12	1.46	1.17	1.74	44.79
20	Peepal tree	4.71	1.25	0.17	0.13	1.56	19.79
21	Indian coral tree	1.58	0.92	0.00	0.00	0.62	18.75
22	Indian lilac	0.79	0.71	0.42	0.17	0.52	38.54
23	Mahagoni	1.21	0.29	0.04	0.00	0.39	10.42
24	<i>Ficus hispida</i>	0.83	0.37	0.00	0.08	0.32	12.50
25	Akashmoni	0.63	0.50	0.08	0.00	0.30	7.29
26	White siris	1.92	1.25	0.63	0.25	1.01	35.42
27	Arjun tree	0.08	0.04	0.00	0.00	0.03	2.08
28	Teak	1.88	1.58	0.75	0.13	1.08	38.54
29	Chickrassi	0.04	0.12	0.08	0.00	0.06	3.12
30	Chapalish	0.08	0.08	0.08	0.00	0.06	5.21
31	Eucalyptus	0.50	0.21	0.00	0.00	0.18	9.37
32	Horsetail tree	1.00	0.83	0.54	0.00	0.59	26.04
33	Royal poinciana	1.88	1.45	0.29	0.00	0.91	30.21
34	Fragrant champaca	0.04	0.00	0.04	0.00	0.02	2.08
Average		18.62	13.47	6.87	4.39	43.4	26.78

3.3. Tree Species Grown and their Selection Criteria in Homestead Forests

Thirty four different tree species were identified in the homesteads of the sample households of which 18 fruit and 16 timber species. Different socio-economic factors such as educational status, occupation, family income and the needs and choice of the family influenced the distribution of the species. From the study, it was found that the average number of horticultural species (34/household) is higher than the timber species (9.42/household) (Table 5). People choose the horticultural species because they got fruit and timber from same tree for fulfill their demand. Farmers were found to prefer fruit trees because of their multiple uses and consumption. Miah *et al* [12] and Bashar *et al* [13] also reported that farmer generally prefers fruit trees in their homesteads. The highest average number of fruit trees was Betel nut (13.93/household), followed by Coconut (7.35/household) and Mango (4.88/household). It was also observed that (99%) households possessed Mango followed by Betel nut (98%) and Coconut (98%). Among timber species 45% households were found to grow Raintree followed by Teak (39%) and White siris (35%). People were found to grow multipurpose tree species to meet their demand of fruit, fuel, timber and fodder not only for household consumption but also for commercial purposes. Multiple uses and commercial values determine species dominance in the home gardens. Among the timber species, the mean number of Rain tree per household was highest (1.74/household) followed by Peepal tree (1.56/household) and Teak (1.08/household) (Table 5).

3.4. Distribution of Individuals of each Species in Different Diameter Classes

In case of distribution of species in different diameter class, it was found that the maximum percentage of individuals (38%) belongs to diameter class less than 10 cm. The lowest percentage (2%) is represented by largest diameter class (>60cm) (Table 6). It is obvious from Table 6 that the percentage number of individuals tends to decrease as the diameter increase. It was also found that different diameters were found to dominate by different species. In horticultural species Mango, Black Berry, Jackfruit, Indian Jujube and Coconut were almost found in all diameter classes, because local people preferred these trees for their multiple uses such as for fruit and timber. On the other hand, in case of timber species, Raintree and White siris were found in all diameter classes because people preferred them for fuelwood and timber (Table 6). Tree species which were found in most of the diameter classes suggests that they were managed sustainably by the households. However, tree species found in lower diameter classes such as Betel nut, Guava, Pomegranate cannot be defined by diameter class because these trees do not attain larger diameter classes. Results also showed that with the increase of tree diameter, individuals (%) in each diameter class decreases. Most of the homesteads were dominated by smaller diameter trees; the reason is that people cut tree before reaching higher diameter for their immediate income or meeting their household needs (Table 6).

Table 6: Distribution of Individuals of Each Species in Different Diameter Classes

Sl No	Species	<10cm (%)	10-19.9 cm (%)	20-29.9 (%)	cm30-39.9 cm (%)	40-49.9 cm (%)	50-59.9 cm (%)	>60 cm (%)
Horticultural Species		31.65	2.33	0.8	.58	42	16	55
1	Mango	5.30	4.21	2.14	2.30	1.10	1.89	1.47
2	Black Berry	0.63	0.42	0.25	0.17	0.13	0.10	0.08
3	Jackfruit	1.47	2.22	1.89	1.68	0.46	0.17	---
4	Indian Jujube	2.62	0.44	0.42	0.38	0.31	---	---
5	Coconut	2.10	3.77	4.56	0.63	0.42	---	---
6	Guava	1.26	1.89	0.84	0.42	---	---	---
7	Litchi	0.21	0.38	0.19	---	---	---	---
8	Olive	0.06	0.17	0.04	---	---	---	---
9	River Ebony	---	0.08	0.21	---	---	---	---
10	Indian Goose Berry	0.17	0.21	0.08	---	---	---	---
11	Betel nut	17.22	7.86	---	---	---	---	---
12	Custard Apple	0.13	0.17	0.10	---	---	---	---
13	Pomegranate	---	0.15	0.06	---	---	---	---
14	Lemon	0.31	---	---	---	---	---	---
15	Papaya	---	0.06	---	---	---	---	---
16	Banana	---	0.12	---	---	---	---	---
17	Bilombi	---	0.08	---	---	---	---	---
18	Grape Fruit	0.17	0.10	0.02	---	---	---	---
Timber species		.10	41	.46	.51	88	.73	42
19	Rain tree	1.48	2.10	1.89	3.12	1.80	0.63	0.42
20	Peepal tree	0.04	0.15	---	---	---	---	---
21	Indian coral tree	0.06	0.19	0.04	0.04	---	---	---
22	Indian lilac	---	0.08	0.04	---	---	---	---
23	Mahagoni	0.01	0.29	0.19	---	---	---	---

24	<i>Ficus hispida</i>	0.13	0.10	----	----	----	----	---
25	Akashmoni	0.17	0.63	0.25	----	----	----	----
26	White siris	0.31	0.42	0.63	0.18	0.08	0.10	----
27	Arjun tree	----	0.22	----	----	----	----	----
28	Teak	3.14	2.10	----	----	----	----	----
29	Chickrasi	0.15	0.23	0.10	0.17	----	----	----
30	Chapalish	----	0.06	----	----	----	----	----
31	Eucalyptus	---	0.19	0.17	---	----	----	----
32	Horsetail tree	0.02	0.06	----	----	----	----	----
33	Royal poinciana	0.21	0.42	----	----	----	----	----
34	Fragrant champaca	0.38	0.17	0.15	----	----	----	----
All Total		37.75	29.74	14.26	9.09	4.30	2.89	1.97
Grant total								100

3.5. Quantitative Structure of Tree Species in Homesteads

From the study, it was found that the average number of tree density of horticultural species (34) is higher than the average number of tree density of timber species (9.42) per household. It was also found that highest tree density of individuals is of Betel nut (13.93/household) followed by Coconut (7.35/household) and Mango (4.89/household). On the other hand, in case of timber species highest tree density is of Raintree (1.74/ household) followed by Peepal tree (1.56/household) and White siris (1.01/household) (Table 7). The overall picture of ecological importance of a

species in relation to the community structure can be obtained by adding the values of relative density, relative frequency and relative cover [11]. These parameters are commonly used to characterize the structure of the vegetation. From the study, it was found that the Relative Importance Value (RIV) is maximum in Betel nut (43.21%) followed by Coconut (31.14%) and Raintree (15.57%). The minimum value is for Arjun tree (2.56%). However, RIV was found higher for horticultural species (10.2%) compared to timber species (7.1%) (Table 7).

Table 7: Tree Density, Relative Frequency, Relative Density, Relative Cover and Relative Importance Value of Each Species at Fatickchari upazila

SI No	Species	Density (No. of Trees/homestead)	Relative Frequency (%)	Relative Density (%)	Relative Cover (%)	Relative importance value (%)
Horticultural species		34.00	3.64	4.33	2.22	10.20
1	Mango	4.89	10.60	11.20	5.86	27.66
2	Black Berry	0.68	1.58	1.55	2.41	5.54
3	Jackfruit	1.90	3.94	4.35	3.38	11.67
4	Indian Jujube	0.66	3.49	1.51	3.48	8.48
5	Coconut	7.35	10.6	16.90	3.64	31.14
6	Guava	0.33	1.35	0.76	1.23	3.34
7	Litchi	0.72	4.62	1.65	2.49	8.76
8	Olive	0.33	1.80	0.76	2.55	5.11
9	River Ebony	0.18	1.24	0.41	2.28	3.93
10	Indian Goose Berry	0.42	3.49	0.96	2.13	6.58
11	Betel nut	13.90	10.70	31.90	0.61	43.21
12	Custard Apple	0.21	1.80	0.48	1.23	3.51
13	Pomegranate	0.22	1.91	0.50	1.12	3.53
14	Lemon	0.39	2.03	0.88	0.35	3.26
15	Papaya	0.69	3.27	1.58	0.44	5.29
16	Banana	0.88	1.58	2.01	2.53	6.12
17	Bilombi	0.15	1.01	0.33	1.59	2.93
18	Grape Fruit	0.09	0.56	0.22	2.67	3.45
Timber species		9.42	2.06	1.35	3.69	7.10
19	Rain tree	1.74	2.14	3.58	9.85	15.57
20	Peepal tree	1.56	4.84	3.99	1.31	10.14
21	Indian coral tree	0.63	2.03	1.43	2.27	5.73
22	Indian lilac	0.52	4.17	1.19	4.58	9.94
23	Mahagoni	0.38	1.13	0.86	3.79	5.78
24	<i>Ficus hispida</i>	0.32	1.35	0.74	2.82	4.91
25	Akashmoni	0.31	0.79	0.72	4.60	6.11
26	White siris	1.01	3.83	2.32	5.24	11.39
27	Arjun tree	0.03	0.3	0.06	2.20	2.56
28	Teak	1.08	4.17	2.49	1.80	8.46
29	Chickrasi	0.06	0.34	0.14	4.88	5.36
30	Chapalish	0.07	0.56	0.17	3.25	3.98
31	Eucalyptus	0.18	1.01	0.41	1.36	2.78
32	Horsetail tree	0.60	2.82	1.39	2.45	6.66
33	Royal poinciana	0.91	3.27	2.08	5.63	10.98
34	Fragrant champaca	0.02	0.23	0.05	3.01	3.29
All		43.40	2.89	2.93	2.91	8.74

3.6. Utilization Pattern of Homestead Tree Resources

It was observed that every tree species in home garden has multiple uses. The primary use of the major trees grown in the homesteads were fruit, timber and building materials and the secondary utilities were fuel, fodder and fencing etc. (Table 8). The major fruit species are Mango, Jackfruit, and Coconut etc were planted primarily for fruit and timber. But, eventually they provide fuel and fodder. Similarly, all other tree species has some additional utility [6]. Some species are also used for juice and making handicrafts, which was found in utilization survey at Noakhali District [14].

Table 8: Relative Importance of Various Uses of Homestead Trees at Fatickchari Upazila

Sl. No	Species	Uses (*)						
		Fruit	Timber	Poles & Rafts	Agricultural implements	Fuel	Trellis & Fencing	Fodder
1	Mango	***	***	---	---	**	---	---
2	Black Berry	***	***	---	---	*	---	---
3	Jackfruit	***	**	---	---	*	---	*
4	Indian Jujube	***	---	---	---	**	*	---
5	Coconut	***	---	**	*	**	---	---
6	Guava	***	---	---	---	***	---	---
7	Litchi	***	---	---	---	**	---	---
8	Olive	***	*	---	*	**	---	---
9	River Ebony	***	*	---	---	**	---	---
10	Indian Goose Berry	***	---	---	---	**	---	---
11	Betel nut	***	---	**	---	*	*	---
12	Custard Apple	***	*	---	---	*	---	---
13	Pomegranate	***	---	---	---	**	---	---
14	Lemon	***	---	---	---	**	---	---
15	Papaya	***	---	---	---	---	---	---
16	Banana	***	---	---	---	---	---	*
17	Bilombi	***	---	---	---	**	---	---
18	Grape Fruit	***	---	---	---	**	---	---
19	Rain tree	---	***	---	---	***	---	*
20	Peepal tree	---	**	***	**	**	*	---
21	Indian coral tree	---	**	**	---	*	*	---
22	Indian lilac	---	**	---	---	**	---	---
23	Mahagoni	---	***	---	---	*	---	---
24	<i>Ficus hispida</i>	---	---	---	---	***	---	---
25	Akashmoni	---	***	---	---	*	---	---
26	White siris	---	***	---	---	*	---	---
27	Arjun tree	---	***	---	---	*	---	---
28	Teak	---	***	---	---	---	---	---
29	Chickrassi	---	***	---	---	*	---	---
30	Chapalish	---	***	---	---	*	---	---
31	Eucalyptus	---	***	---	---	*	---	---
32	Horsetail tree	---	***	---	---	*	---	---
33	Royal poinciana	---	*	---	---	**	---	---
34	Fragrant champaca	---	***	---	---	*	---	---

Note:***Most importance; **Moderate importance; *Minor importance

3.7. Non-Timber Forest Products (NTFPs) in Homestead Forest and their Uses

During the survey several NTFPs were found in the homesteads. NTFPs were widely distributed in the homesteads. Major NTFPs found in the homesteads are shown in Table 9 with their uses. It was observed that 53% of the family used bamboo as their construction purposes, handicrafts making, fodder and fuel followed by *Clinogynae dichotoma* (40%) as making handicrafts, mat and baskets (Table 9).

Table 9: NTFP's in Homestead Forest and Their Uses.

Name of the NTFP's	Uses	% of household
Bamboo	Bamboo leaves used as fodder for cattle during the period of scarcity.	53
	For construction purposes like foundations, frames and floors.	
	Dead branches, dried leaves, dead culms, old culms and dead rhizomes used fuel.	
<i>Clinogynae dichotoma</i>	For making pati or sital pati	40
	For making mats and baskets.	
Cane	Also used as fuel wood.	35
	Used as binding materials.	
Spices	For household work.	20
	Used for cooking food.	
	Giving aroma to the food.	

3.8. Medicinal Plants in the Home Garden and their Uses

About fourteen species of medicinal plants were identified in the home gardens. But even any part of any tree can be used for medicinal purposes. The villagers identified these species as medicinal plants from their traditional knowledge. Sometimes they gather knowledge from the village Kobiraj who sells ayurvedic medicine in different market place.

Table 10 shows the different medicinal plants found in the home gardens including their parts used and respective uses. It was observed that Margosa tree (41.67%) and Fenugreek (36.46%) are highly used by the local people than other medicinal plants (Table 10).

Table 10: Medicinal Plants Found in the Homesteads Including Their Uses

Sl. No	Species	Parts used	Name of the diseases	Using patterns	% of house hold practice
1	Malabar Nut	Leaves	Cough	The bruised leaves are mixed with water and drunk.	20.83
2	<i>Centella asiatica</i>	Whole plants	Dysentery	The whole plant crushed in pestle, mixed with salt and eaten with rice.	10.42
3	White siris	Tender leaves	Ring worm	The tender leaves mixed with onion, salt and eaten with rice.	5.21
4	Margosa tree	Bark, leaves	Fever, skin disease, diarrhea, Insect bites.	The bark and leaves are boiled with water. After decanting the warm water is used for bathing to cure skin disease while leaf pest applied over the wounds.	41.67
5	Papaya	Fruit	Constipation	The green fruit cooked and eaten as vegetable while the ripe one is eaten raw.	31.25
6	Indian Goose Berry	Fruit	Blood dysentery, Vomiting, constipation.	The fruits are soaked in water over night, after decanting water is drunk.	20.83
7.	Guava	Fruit and leaves	Wounds, dysentery, diarrhea	The fruits astringent and used in diarrhea and dysentery. Leaves are stringent for wounds.	10.42
8	Giant taro	Tuber, leaves	Constipation	The green leaves are cooked eaten as vegetable.	15.63
9	Fenugreek	Leaves and bark	Jaundice, leprosy and sexual disease	The leaves are soaked in water over night after decanting the water is drunk.	36.46
10	Arjun tree	Bark and fruit	Heart disease, fever.	Bark is crushed eaten for heart diseases.	12.50
11	Banana	Fruits, leaves & tannins of stem	Dysentery, diarrhea, intestinal worms	The green fruits and stem are cooked and eaten as vegetable.	10.42
12	Turmeric	Rhizome	Aromatic, weakness and stimulant	Rhizome are used as green stage	15.63
13	Bitter gourd	Leaves, fruits	Fever, diabetes	Decoction of leaves used in Fever and diabetes.	22.92
14	Mango	Leaves, tender sticks of twigs	Wounds, Diarrhea, Tooth ache, Fever	Decoction of leaves used in fever, Diarrhea and Tooth ache. Tender sticks placed in the fire, when the flame is blown out the warm secretion are applied to the wounds.	8.33

3.9. Vegetables and Spices Found in the Homesteads of Fatickchari Upazila

vegetables and spices in their homesteads for meeting their daily needs and also for income generation (Table 11).

Farmers were also found to grow different kinds of

Table 11: Vegetables and Spices Found in the Homesteads of Fatickchari Upazila

All year	Summer vegetables	Winter vegetables	Spices
Papaya, Giant taro, Indian spinach	Bitter gourd, Ladies finger, Wax gourd, String bean, Elephant foot aroid, Bottle gourd, Cucumber	Tomato, Potato, Sweet gourd, Hyacinth bean, Brinjal	Chilli, Turmeric

Table 12: Investment Analysis of Major Fruit and Timber Species at Fatickchari Upazila

Sl No.	Species name	Cost and Return		
		Total cost (BDT/tree)	Total revenue (BDT /tree)	Net Benefit (BDT /tree)
Horticultural species		88	2337	2249
1	Mango	136	4281	4145
2	Black Berry	96	4227	4131
3	Jackfruit	264	4419	4155
4	Indian Jujube	181	2093	1912
5	Coconut	105	3545	3440
6	Guava	65	1259	1194
7	Litchi	134	5737	5603
8	Olive	80	3375	3295
9	River Ebony	111	3303	3192
10	Indian Goose Berry	81	2619	2538
11	Betel nut	75	1083	1008
12	Custard Apple	67	2775	2708
13	Pomegranate	45	240	194
14	Lemon	46	362	317
15	Papaya	41	168	128
16	Banana	9	129	121
17	Bilombi	15	164	150
18	Grape Fruit	43	2289	2246
Timber species		55	3255	3200
19	Rain tree	57	4752	4695
20	Peepal tree	25	2109	2084
21	Indian coral tree	19	2210	2191
22	Indian lilac	42	2403	2361
23	Mahagoni	76	4633	4557
24	<i>Ficus hispida</i>	25	1481	1456
25	Akashmoni	96	4197	4101
26	White siris	136	5299	5163
27	Arjun tree	26	3100	3074
28	Teak	96	7027	6931
29	Chickrassi	60	307	247
30	Chapalish	58	3044	2986
31	Eucalyptus	35	4241	4206
32	Horsetail tree	50	3333	3282
33	Royal poinciana	30	1182	1152
34	Fragrant champaca	55	2765	2710
Total (Average)		73	2769	2696

3.10. Investment Analysis of Major Fruit and Timber Species

In order to evaluate the profitability of major fruit and timber tree species, investment analysis was employed considering the timing of benefits and costs throughout the routable period of specific trees. The results of financial analysis of different fruit and timber trees are presented in table 12. It was revealed that all fruit and timber trees were found profitable because of low cost of management and high benefits. The average cost and benefit for all species in the study area were BDT 73 and BDT 2696. Among the fruit trees Litchi was found highly profitable since it gives higher benefit (BDT 5603). It was also revealed that among the timber trees Raintree was highly profitable because of its higher benefit (BDT 4695). The lowest return was calculated from Banana trees (BDT 121) (Table 12).

3.11. Income from Different Homestead Forest Resources

It was observed that smaller farm category dependent more on their home gardens and smaller farmer intensively cultivated their home gardens. This might be the reason for getting more income from their home gardens. The farmers of the study area do not practice home garden primarily for cash income except a least number of marginal farmers. The annual income from home garden (fruit, timber, fuel wood and vegetables) ranged from BDT 8257 to BDT 28678 with the mean value of BDT 17676 according to farm categories (Table 13). Income from fruit trees (BDT 8076) was found more in all farm categories followed by income from timber (BDT 5164). However, marginal homesteads were found to earn more income per unit area compared to other homestead categories. This might be due

to their tendencies to produce more from very limited area (Table 13).

Table 13: *Income from Different Homestead Forest Resources*

Household category	Sources of income					Total BDT/year	BDT/ha/year
	Fruit BDT/year	Timber BDT/year	Fuel wood BDT/year	Vegetable BDT/year			
Marginal	3812	2875	680	890		8257	165140
Small	4460	2980	982	1490		9912	90109
Medium	10980	7912	2855	2112		23859	140347
Large	13050	6890	3518	5220		28678	143390
All farm	8076	5164	2008	2428		17676	133404

3.12. Structure of Homegarden Vegetation

The structure of home garden vegetation can be defined by two components: (i) the horizontal arrangement of species, i.e. the spatial distribution of individuals; and (ii) The vertical arrangement of species i.e. the stratification of vegetation.

3.12.1. Horizontal Structure

On the basis of planting locations the home garden

species can be divided into 3 categories; species for border only, species for interior only and species for both border and interior. Out of all species most of the villagers planted in border only of home garden. These include all timber trees, selected tall fruit trees i.e. Black Berry, Coconut, Betel nut, Indian Goose Berry etc. In interior part of home garden Lemon, Papaya, Indian Jujube, Guava are planted (Table 14).

Table 14: *Horizontal Structure of Home Garden Species*

Category of place	Name of species
Back yard	Coconut, Mahagoni, Jackfruit, Mango, Betel nut, Banana, Giant taro, Guava, White siris, Indian Jujube, Indian Apple, Tamarind, Bamboo, Teak
Front yard	Olive, Guava, Kantha, Indian Jujube, Black Berry, Betel nut, Raintree, Indian coral tree, White siris
Corner	Indian coral tree, Koroi, Margosa tree, Indian Jujube, Betel nut
Around the home	Indian lilac, Ginger, Turmeric, Koroi, Dates, Black Berry
Banks of ponds	Coconut, Betel nut, Palmyra Palm, Mahagoni, Teak, Mango, Indian Jujube, Banana
Around water bodies	Giant taro, Water spinach, Marsh herb

3.12.2. Vertical Structure

Table 15: *Vertical Structure of Home Garden Species*

Height(m)	Name of the species
0.5-1	Vegetables, medicinal plants, tubers
2-4	Food plants e.g. cassava, papaya, and banana
5-7	Saplings of fruits/timber trees
8-10	Fruit/timber trees some growing taller
Above 10	Fruit/timber trees

The upper layer of homegarden consists of different fruit

and timber trees such as Mango, Jackfruit, Coconut, Koroi, Betel nut etc. Indian Jujube, Banana, and some ornamental bushes such as Baganbillash and shrubs occupy middle layer from 2m to 7m. Lower layer consists of guava and some granate (Table 15). The ground layer consists of vegetables.

3.13. Constraints of Tree Growing in the Homesteads

Various constraints like physical, technical and socioeconomic were identified in case of tree growing in the homestead by the farmers. Lack of technical knowledge was the most common constraint of tree growing which was reported by 64% of the household. Unavailability of space (62%) and lack of good seedlings (57.5%) were reported to be the other constraints. Large farmer had largest homestead areas.

Table 16: Constraints of Planting New Trees on the Homesteads

Sl. No.	Constraints	% of household				
		Marginal	Small	Medium	Large	All farms
1	Lack of good seed/seedlings	65	60	55	50	57.5
2	Lack of technical knowledge	75	68	64	49	64.0
3	Unavailability of space	76	60	63	50	62.3
4	Restricted sunshine and air	38	35	42	39	38.5
5	Problems of livestock rearing	30	32	31	28	30.3
6	Conflicts with neighbors	15	10	16	20	15.3
7	Problems in poultry and duck rearing	12	9	3	4	7.0
8	Attack of insects and diseases	14	12	8	6	10.0
9	Other member of the family do not like	12	20	29	23	21.0
10	Hampering vegetables production	30	29	28	21	27.0

Major constraints of planting new trees on households are restricted sunshine and air (38.5%), problems of livestock rearing (30.3%), hampering vegetables production (27.0%), other member of the family do not like (21%), conflicts with neighbours (15%) (Table 16). Lack of technical know-how was the most common constraints, which was found in homestead utilization survey at Noakhali District and lack of good seed/seedlings was the next common constraints [14].

3.14. Management System of Homestead Forest

The management system of homestead forest has resolved as a response of many factors, such as cultural, economics, environmental and personal preferences. All the management activities should be given more attention for maximum production.

3.14.1. Management Techniques

Homestead forests were found very poorly managed in the area surveyed. Management activities include protection, fertilization, irrigation, pest control, weeding, mulching and other cultural treatments. It is one of the most important aspects of homestead farming for homestead land use [12]. Management activities were found to be done at various stages such as before planting, seedling stage, sapling stage, tree stage etc. and were almost limited within the farmers of medium and large categories. Almost all the species were planted irregularly, densely populated and usually without pest control. Only the high valued species were found to receive protection from livestock by erecting bamboo gabions by all categories of farmers.

To improve soil fertility the farmers usually use cow dung as manure at the initial stage of planting. Before planting, they generally use 1-2 kg of cow dung in the fit and no other organic fertilizer are usually used there after. But several authors [12, 15, 16] report that farmers generally use farm yard manure and organic manure/compost for the soil fertility management of their home gardens and application of chemical fertilizer is very rare and limited to valuable species only during early stage of development and during fruiting. However, the tendency

of using manure and fertilizers was relatively higher in the medium and large farm categories. Pruning was usually done for some fruit species like Coconut, Dates, Mango, Jackfruit, Indian Jujube etc. but no time schedule was followed for this purpose. Pruning was carried out either for the improved fruit production or for the recover of fuel wood crisis. According to Alam *et al* [16], the farmers of Jessore District of Bangladesh prune their home garden plants mainly for four reasons which in accordance of preference are: to get more fruits, to get more quality fruits, to get fuel wood, and to ensure more space for sunlight. Occasionally, weeding was done for some horticultural species, but the tree species suppressed by bush, herbs and shrubs had been found in the area surveyed. Mulching was also found to be a rare condition. In controlling insect, pest and disease most of the respondents applied ash on the growing vegetables and seedlings or saplings of tree species. In severe case insecticides were used. Usually the rural people of the study area ignore the pest and diseases of tree seedlings.

3.14.2. Sources of Planting Materials

Generally most of the rural people were dependent on outside sources other than own source for seeds or seedlings as planting materials. Majority mentioned market (50%) as the source of planting materials (Table 17).

Table 17: Sources of Planting Materials

Types of sources	Percentage of the sources
Home gardens	20
Relatives	1
Neighbors	2
Govt.	5
NGO	3
Nursery	15
Natural wildings	2
Market	50
Friends	2
Total	100

3.14.3. Types of Planting Materials

The villagers have intimate knowledge about different seedlings; vegetative propagates which all the farmers practice to regenerate plants in homegarden use. Most of the food and fruit producing species are produced from seeds/seedlings. The rest of the species are vegetative propagate (Table 18).

Table 18: Knowledge of Silviculture

Item	Reason for use	Reason for not use
Seed	Easy to grow; Easily available	Less survival rate; More damage; Insect attack easily
Seedlings	Better survival rate; Less damage	Costly Not readily available
Vegetative propagates	Better survivality Easily available Growth is fast	Costly

3.14.4. Cropping Pattern

The villager did not follow any particular pattern. They planted trees any where in the homesteads whenever the spare is available. The farmers followed three types of cropping pattern, which shown in Table 19.

Table 19: Cropping Pattern Followed by the Farmer

Cropping pattern	Types of species	Example
Short rotation species	Vegetables	Ladies finger, Tomato, Potato, Red amaranth and spices like Turmeric
Medium rotation species	Shrubs	Banana, Lemon, Guava and Papaya
Long rotation species	Tree	Mango, Jackfruit, Black Berry, Mahagoni, Akashmoni, Teak

3.15. Villagers Attitudes towards Homestead Forest

The reason why the farmer planted trees in their homestead is shown in Table 20. Most of them showed positive attitude for meeting timber (80%) and fruit (70%) demand. A considerable percentage of respondents also mentioned positive attitude towards environmental and health improvement (65%) (Table 20).

Table 20: Reasons for Planting Trees in the Homestead

Reasons	Respondents attitude	
	Positive (%)	Negative (%)
To meet the demand of timber in the home garden	80	20
Supply fruit for the homestead	70	30
Protection to the homestead from natural calamities	40	60
Provide shade and keep the house cool	40	60
Supply of poles for construction purposes	20	80
Provide better Environment and improve the health	65	35

3.16. Role of Male and Female in Tree Planting and Management

Almost all decisions regarding selection of species, selection of place, collection of seedling, planting, pruning, selling of produces and use of money are taken by the male in the study area. Women are only allowed to take decision regarding selection of place, selection of species and use of money. Although, most of the respondents admitted the contribution of women in home garden, their participation in the decision making process is not significant in the study area. From the study, it was found that 52% male and 48% female were participating in the management of home garden (Table 21). It was also observed that women of large category were more confined to their houses. Male members mainly contributed in planting, large scale weeding, pruning etc. There were no particular time allocation for a day by both male and female on tree management. Hossain *et al* [15] reported that in Bangladesh, women are mostly involved in the pre and post-harvest work of vegetable production while men play key role in timber and fruit tree growing activities. Women play a most active role in the development and the maintenance of the home gardens.

Table 21: Role of Male and Female on Tree Management in the Sampled Household

Sex	Average no./ household	% of participants
Male	3.18	52
Female	2.97	48
Total		100

4. Conclusion and Recommendation

4.1. Conclusion

Homestead forestry practices in Bangladesh are still at traditional level in terms of management practices and use of trees. Farmers depend largely on the naturally growing trees in the crop fields. Systematic plantation is becoming popular slowly on the recent years. Farmers do not seem to make vigorous effort to maximize the returns from the tree crop interface. Although trees are used for various purposes, the only systematic use seems to be extraction of juice from the date palm trees. Proven technologies are not yet available for improvement of the traditional agroforestry systems; extension support is almost nonexistent. Agroforestry research on carefully thought out agenda is the urgent meet of time. The research must be based on farmers own knowledge of the trees and the farming systems.

The increasing population of Bangladesh is creating demand for more food, fuel and timber thus resulting in rapid deforestation. To meet the demand of fuel energy people are burning cow dung and crop residues thereby limiting their use as organic manure. Therefore, soil fertility

is declining at an alarming rate. This study revealed that, Fatickchari Upazila possesses diversified tree species but their occurrence is not satisfactory. Due to the lack of well management practice and the lack of awareness about the ecosystem, many of the important tree species are in danger. Tree species, are the important components of the homestead forestry resources of Bangladesh. They play a vital role to satisfy the local needs and demands. The homestead forest is also keeping the balance of ecosystem. Tree species diversity plays an inevitable role in the conservation of species and also of the current environmental issue of Bangladesh, as well as other tropical countries. But unfortunately the threatened and endangered species are becoming extinct day by day due to lack of consciousness and knowledge about homestead forestry resources. It was reported that many species had exterminated by people and many were threatened by some manmade causes. Now, increased populations of Bangladesh are facing acute fuel wood, timber and fodder problems. Homestead forestry resources can allow this distortion substantially as the homesteads are supplying about 70% of timber, 90% of fuel wood, 48% of sawn and veneer logs and almost 90% of bamboos required by the nation [17].

Homestead vegetation of Fatickchari area typically exhibits in a layered vertical structure of diversified economic crops of importance value and domestic usage. The upper stratum comprises of timber and fruit trees. Middle and lower is usually occupied by fruit trees and bamboo clumps and the lower stratum are occupied by seasonal vegetable and small bushes. The distribution of land among the farmers was highly unequal causing poverty to a group of landless people. But the poor Farmers tried to use their small land very effectively. Financial analysis of use to horticultural and timber species shows that average cost smaller than the average benefit. This indicates long-term investment on fruit and timber trees is profitable. Though, it was revealed from the study that timber species yield more economic results than the horticultural species. Farmers showed a particular preference to horticultural species because fruit trees provide immediate cash return and contribute to household food and nutrition requirement whereas large and medium households preferred timber trees for greater economic return despite of the longer rotation.

A well-managed homestead forest can afford to appear the food, fodder and fuel wood demand of the rural people as well as to provide raw materials for rural small-scale cottage industries, increase rural as income and employment opportunity of the rural inhabitants. It will bring the prosperity to the poor village people.

4.2. Recommendation

During the survey it was found that the conditions of homestead forests resources are not good. However, the following suggestions are recommended to increase the forest cover in the homesteads.

- In homesteads, unused land is available around most of the households; the unused land can be planted with multipurpose tree species to meet the demand for timber, fuel wood, fruit, fodder and raw materials etc. This will increase the income and employment opportunity of the household owners. This unused land can also be planted with fruit trees such as Berry, Papaya, Jackfruit & fast growing species such as Mahogany, Akashmoni and Bombay blackwood & Eucalyptus etc.
- The villagers are not aware about agroforestry. They have an idea that agri-crops does not grow with forest species, so proper training and demonstration is necessary to change their current thinking. The entire agricultural boundary should be planted with Eucalytus, Mahogany, Banana, Coconut, Papaya etc.
- The cattle and goats of the homesteads used to graze on road sides, field crops boundary and around the homesteads. Most of the cattle are feed on crop residues mainly rice straw, which is very poor quality fodder. So to make fodder available for cattle, a small part of all the homesteads should be planted with fodder species.
- The villages do not follow any cropping pattern. They plant trees, wherever, the space is available. So training would be beneficial to overcome this situation.
- Women participation in the homestead agroforestry practice should be encouraged for its wholesome development. If the women are encouraged in homestead forestry than it could be better protected, since women are always available in the homes.
- NGO's should be involved in the improvement of homestead agroforestry system. They can take part to motivate in the improvement of homegarden, disseminate improved technique of tree planting, distribute improved variety of seedlings etc.
- Improved seeds and seedlings from horticultural forest extension nurseries should made available to home gardeners with minimum price. This will increase the people to plant more trees in their own homesteads.
- Establishment of private small scale nurseries in rural areas to produce good seedlings of different species should be encouraged, which will ultimate lead to the improvement of the homestead forest and its species compositions.
- Forest Department should include homestead forestry as a component as priority basis where they can disseminate knowledge and distribute quality seedlings to improve the homestead forest.
- Mechanism should development to regularly monitor and evaluate homestead forestry and development activities.
- Finally, to increase production from the homestead forest, following specific recommendation are suggested -
 - ❖ Increasing the number of fast growing species in order to provide early cash return to the villagers.

- ❖ Removal of large, over matured fruit trees and their partial replacement with high yielding variety trees.
- ❖ Partial removal of unproductive species as for example Ficus (Bot) and Erythrina (Indian coral tree).
- ❖ Grazing areas boundary of paddy fields should be planted with light foliage, fast growing species on a very short rotation, e.g. Eucalyptus.

References

- [1] Fernandes, E.C.M. and Nair, P.K.R. 1986. An Evaluation of the structure and function of Tropical Home gardens, *Agricultural Systems* 21(4):279-310.
- [2] Leuschner, W.A. and Khaleque, K. 1987. Homestead agroforestry in Bangladesh. *Agroforestry systems*, Vol.5, pp.139-151.
- [3] Mustafa, Millat-e- et al. 1996. The ecology and management of traditional homegarden in Bangladesh. Ph.D. Thesis. University of Wales, UK.
- [4] Das, S. 1986. The Forest Management practices in Bangladesh. Proceedings in second National Conference on Forestry. Bangladesh forest Department, Dhaka. pp 6-18.
- [5] Haque, M.A. 1994. *Agroforestry in Bangladesh* (etd.), joint publication of Swiss Development Cooperation, Dhaka and Bangladesh Agricultural University, Mymensingh.
- [6] Abedin, M.Z. and Qudus, M.A. 1990. Household fuel situation, homegardens Agroforestry practice at six agroecologically-different contains of Bangladesh. In: Abedin, M.Z.; Lai and M.O. Ali (eds), *Homestead plantation and agroforestry in Bangladesh*. Proceedings of a national workshop held July 17-19, 1998 in gazipur-1701, Bangladesh. pp.19-34.
- [7] Giri C and Shrestha S. 1996. Land cover mapping and monitoring from NOAA AVHRR data in Bangladesh. *International Journal of Remote Sensing* 14: 2749–2759.
- [8] FAO. 1995. *Forestry Statistics Today for Tomorrow*. Food and Agriculture Organization of the United Nations, Rome, Italy
- [9] Imam MH (1991) *Social forestry perspective and Bangladesh*. *Asian Profile* 19(2): 185–192.
- [10] BBS, 2006. *Census of Agriculture 1996*, Zila series: Chittagong. Statistical division, Ministry of Planning Dhaka, Bangladesh.
- [11] Shukla, R.S. and Chandle, P.S. 2000. *Plant Ecology and Soil Science*, S. Chand and Company, Ram Nagar, New Delhi, India.
- [12] Miah, G., Abedin, M.Z and Khaier, A.B.M.A., Shahidullah, M., Baki, A.J.M.A. 1990. "Homestead plantation and household fuel situation in Ganges flood plain of Bangladesh." In: M.Z. Abedin, C.K. Lai and M.O. Ali (eds), *Homestead plantation and agroforestry in Bangladesh*. pp.120-135. BARI. Joydebpur, Bangladesh.
- [13] Bashar, M.A. 1999. *Homegarden Agroforestry: Impact on biodiversity conservation and household food security*. (A case study of Gazipur district, Bangladesh). M.Sc. Thesis, Agricultural University of Norway, Oslo, Norway.
- [14] Uddin, M.J. and Hasan M.K. *Economics of Homestead agroforestry at char areas at Noakhali district*. On- Farm Research Division, Bandarban and Gazipur.
- [15] Hossain, S.M.M., Abedin, M.Z., Hossain .M.S. 1988. Women's role in homestead plantation. Paper presented in the National workshop homestead plantation and agroforestry in Bangladesh. Held in July 17-19, 1988. in Joydebpur, Bangladesh.
- [16] Alam, M.S., Haque, M.F., Abedin, M.Z. and Akhter, S. 1990. Homestead trees and household fuel uses in and around the FSR site, Jessore. In: M.Z. Abedin, C.K. Lai and M.O. Ali, (eds), *Homestead plantation and agroforestry in Bangladesh*. pp106-19. BARI. Joydebpur, Bangladesh.
- [17] FAO, 1982. *Village Forest Inventory, Bangladesh*. Projects Findings and Recommendations. Terminal Report, FAO:UNDP/BGD/78/020, P.25.