



## Structure, species composition and utilization of homestead forests in Gangni Upazila of Meherpur district, Bangladesh

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### Abstract

*In Bangladesh, homestead forest is one of the most important natural resources and it comprises a mixture of diversified plant species. The study aims to explore the structure of homestead forest, species composition, species frequency and diversity, uses and importance of homestead forests. It particularly focuses on the some aspects of the study area like structure of homestead forest, status and species composition, species frequency and diversity, homestead size, demographic and socio-economic status of the respondents and household owners' attitudes towards homestead forests, uses and importance of tree based products and services. This study was carried out by using mixed method followed by a semi-structure questionnaire and a homestead forest inventory form. The unions and villages were selected for the study by using a multistage random sampling. A total of 60 respondents homestead forests were selected by using snowball purposive sampling method. This study revealed that about 60% of the total homesteads were medium, 30% small and only 10% large size with reference to the size of homestead forests. Overall homesteads forest was within the ranges of 0.03 ha to 0.4 ha. The average of homesteads forest was 0.12 ha and the total study area was 7.05 ha. The study found that 73 plant species (including tree, shrub and herb) under 39 families identified and recorded in the study area. Trees and herbs species were predominated accounting for about 82% of all the identified species. Four canopy strata were observed by the researchers and fruit species were dominated near the living quarter in the respondents' homesteads. They planted (68.33%) most of the species in their homestead in the border and interior parts. About 60% homestead forests contained the number of species ranges between 16-30 species. Moreover, mango (fruit species) and mahogany (timber) were the most important and dominant tree species in the study area. The study explored that among the 15 important plant species (5 trees, 5 shrubs and 5 herbs) 6 were native and 9 were exotic according to their origin, uses and relative frequencies. The majority of the respondents preferred fruit and timber species in their homesteads for future investment and as a reserve bank of resources.*

**Keywords:** Homestead Forests, Structure, Composition, Species Frequency, Utilization.

### Introduction

Bangladesh, being a subtropical country, occupies a wide range of diversity of plants in homestead forests. Homestead forests, popularly known as home garden, is an important component of rural economy in Bangladesh. It is an integrated and continuous production system and maintains biological diversity and wealth<sup>1-2</sup>. Land is the basic resources of human society. Bangladesh is an over populated and land hungry country. It has about 14.4 million hectares of land with population of 149.77 million<sup>3</sup>. Bangladesh has 2.6 million hectares of forestland covering about 17.62% of the country's area. Bangladesh Forest Department controls, manages and protects only 10.84% (1.6 million hectares) of the total forest area<sup>4</sup>. Bangladesh annually lost 2600 hectares of primary forest and annual rate of deforestation was 0.2% between 1990 and 2015. Contrarily, Global Forest Resources Assessment shows that the total forest area of Bangladesh is 1.429 million hectares and 11% of the total land area of the country<sup>5</sup>. Homestead forest focuses a land use system involving deliberate management of multipurpose trees and shrubs in close association with seasonal vegetables<sup>6</sup>.

A wide variety of factors may be associated with homestead forest diversity and structure, including biophysical features such as biogeography, proximity to forest and elevation<sup>7-11</sup>. The homestead forests are the most highly productive forest and meet most of the demand of timber and fuel wood in the country<sup>12</sup>. Homestead forest plays an important role in supplying fuel wood, fodder, medicine, fruit and timber.

It is estimated that about 90% of fuel wood, 70% of timber, 48% of sawn and veneer logs and almost 90% of bamboo requirement are met from homestead forests<sup>13</sup>. It also can play a vital role as a source of employment and income generating activities all the year round and thus these are more important and dependable to the rural people in the area. These can ensure the uplift of the socio-economic status of the area<sup>14</sup>.

Homestead forest occupies 2% (2951.40 km<sup>2</sup>) of the total land area of Bangladesh, which spreads over 20 million homesteads. Recently, forest department estimates 14.6% of the total land area of Bangladesh as forested, but in reality, only about 6-8% of the total land area merits the term forested. Specifically 6.4%

of total land areas of Bangladesh under tree cover<sup>15</sup>. Bangladesh is a small country and never had huge forest resources.

The per capita of forest area in Bangladesh is less than 0.015 hectare against the world where average is 0.60 hectare<sup>16-17</sup>. It is difficult to meet the country's huge demand for timber, fuel wood, fruit and fodder from the existing natural resources. Bangladesh has a long heritage of growing timber, fruit trees and medicinal plants along with other perennial shrubs and herbs specially, in rural areas<sup>18</sup>.

Meherpur district is one of the forests absent districts where have no state-owned natural forest<sup>19</sup>. The respondents introduced different types of fruit and timber species with seasonal vegetable in their homesteads in the study area. They are adopting integrated land use systems to increase their food production and cash income. Gangni Upazila of Meherpur district was selected purposively because it has a reputation of cultivating various types of fruit crops, woody and timber species and as well as producing huge amount of seasonal vegetables. But there is no natural forest<sup>20</sup>. Homestead forests are becoming popular in the study area. But no study was so far conducted till now, on the structure, species composition and utilization of homestead forests specific to this area. Therefore, the study on structure, status and species composition, species frequency, diversity and benefits of homestead forest as well as its utilizations was necessary to make the people aware about the importance of homestead forests. Finally, the study was conducted to explore the present status of homestead forests through investigating the plant species composition, species frequency, diversity and structure as well as the utilization of tree based products and services of homestead forests.

## Materials and Methods

**Study area:** The study was conducted in Gangni Upazila of Meherpur district from southwestern part of Bangladesh (Figure-1). This Upazila is bounded on the north by Daulatpur Upazila of Kushtia district and on the east by Mirpur Upazila of Kushtia district and Alamdanga Upazila of Chuadanga district

and on the south by Meherpur Sadar Upazila and on the west by India. It covers an area of 363.95 sq. km. and consisting of 9 Unions and 137 villages. The total population and household units in the study area is 299607 and 77580 respectively. It is located between 23°44' and 23°52' north latitudes and between 88°34' and 88°47' east longitudes. The temperature ranges from 11.2°C to 37.1°C and the average annual rainfall is about 1467 mm. the rainy season commences in the middle of June and continues up to the end of September. The soil mainly calcareous brown flood plain and composed of alluvium and sandy clay with a good percentage of potash and phosphate. This area contains fresh water and the soil is free from salinity. The land is totally cultivated of this area, but not much natural vegetation is left. The landscape is mostly occupied with mosaic croplands/vegetation<sup>21-22</sup>.

**Sampling design:** The study was conducted in Gangni Upazila and Meherpur district. The unions and villages were selected for the study by using a multistage random sampling. Among the three Upazillas of Meherpur district, Gangni Upazila was selected purposively. A total of 6 unions from 9 unions and 6 villages (1 village from 1 union) were selected randomly where homestead forest was practiced (Figure-1). The sample size was 60 respondents who practiced homestead forest in the study area. They were selected from 6 villages (10 respondents from each village) by using snowball purposive sampling method. Random sampling was not possible in the field situation due to unavailable reliable data on the respondents in this study area.

**Data collection process:** This study was conducted by using mixed method followed by a semi-structure questionnaire and a homestead forest inventory form. The study was conducted during 2014-2015. Data collection process was done by two ways.

**Inventory Part:** A botanical inventory was conducted in each homestead forest by using a "Homestead Forest Inventory Form".

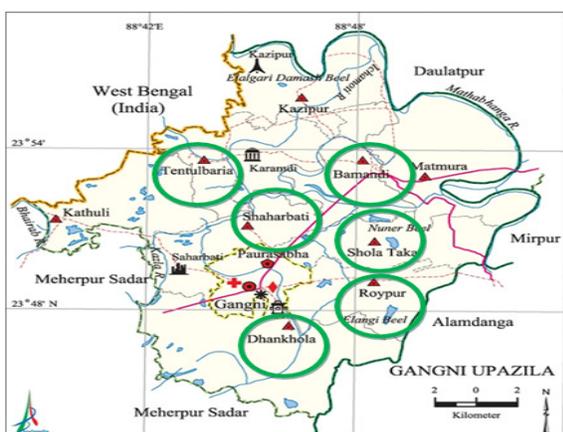


Figure-1: Location and Map of the study area (Circle signs indicate Union)<sup>23</sup>.

**Horizontal structure:** Plant species were divided into three categories on the basis of planting location in homestead area such as only in border, only in interior and both border and interior<sup>24-25</sup>. Every individual of trees and shrubs were counted. In case of herbs only species were recorded<sup>26</sup>.

**Vertical structure:** Canopy was stratified into four strata on the basis of specific height classes. These were ground stratum (up to 2m), under storey stratum (above 2m to 5m), middle canopy (above 5m to 15m) and top/over storey stratum (above 15m). A scaled measuring pole, measuring tape, a SUUNTO clinometer and Haga altimeter were used to measure the heights<sup>27-28</sup>.

**Plant species composition:** All plant species in each homestead forest were identified and recorded on the basis of their domesticity and origin<sup>27, 29-30</sup>.

**Frequency and relative frequency of plant species:** Frequency and relative frequency of plant species were estimated by two recognized formulae<sup>31-32</sup>. These are given below:

$$\text{Frequency (\%)} = \frac{\text{No. of samples in which the species occurred}}{\text{Total no. of samples studied}} \times 100$$

$$\text{Relative Frequency} = \frac{\text{No. of Occurrences of the species}}{\text{Total no. of occurrences of all the species}} \times 100$$

**Questionnaire survey:** A semi structured questionnaire survey was conducted on 60 homesteads for the utilization and importance of homestead forests. The necessary data and information were collected from the respondents through face-to-face interviews using mixed method followed by a semi-structure questionnaire. They were asked different questions related to land uses to collect required information to fulfill the objective of this study. The survey was conducted on the variety of choices of species, use of tree species, attitudes towards homestead forests, problems of homestead forests and explored demographic and socioeconomic indicators of the respondents<sup>33</sup>. For this study, a preliminary survey was administrated for pre-tested questionnaire and determined the socio-economic condition in relation to farm size of the households in the villages.

**Data processing and analysis:** All the collected data and information were reviewed, sorted and analyzed carefully and systematically according to the objectives of the study. Each recorded species in the homestead forests was categorized by family, habit (tree, shrub and herb), domesticity (planted vs. naturally established), origin (native to the Indian subcontinent vs. exotic or introduced) and stratum: ground layer (up to 2m), under storey (above 2m to 5m), middle canopy (above 5m to 15m) and top layer or Over storey (above 15m) and use by local people<sup>27,34</sup>. Frequency (the fraction of homestead forests occupying the species) for each species of tree, shrub and herb (except those planted in hedgerows) were computed. Relative

frequency of plant species was used to rank species<sup>35,36, 27</sup>. After sorting information, data were compiled sequentially and systematically. Then collected data was analyzed in percentages for easy explanation with tables, graphs etc. MS Excel package was used to analyze these field survey data.

## Results and discussion

The findings of this study also confirmed that homestead forest was truly rich in plant species composition and represented an intensive delicate structure of multi-layered species.

### Demographic and socio-economic status of the respondents:

The study was carried out to reveal the demographic and socio-economic status of the respondents such as age distribution, educational status, occupation, household size and family income. The age of the respondents were categorized into three groups<sup>37</sup>. Among the respondents about 57% were the middle aged (36-50 years old) followed by about 25% old-aged (above 50 years old) and only 18% (up to 35 years old) were young. In all the studied villages the occupation of the majority of the respondents (about 63%) were agriculture and practiced agricultural cultivation in their farmlands. Some of them had businesses (17%), services (10%) and others (10%). It was remarkable that most of the respondents (91%) were literate (Table-1). Education is an essential socio-economic variable that may make a respondent more respective to advice from an extension agency or more able to deal with technical recommendations that need a certain level of literacy<sup>38</sup>. The average household size of the respondent was 5.8 members in the study area. About 27% of them had small family size up to 4 members and majority of them (about 73%) had large size between 5-8+ members (Table-1). The average family size of Bangladesh is 4.5 members which indicate large family size of the study area<sup>39</sup>. Most of the respondents (52%) annual income range was Tk. 75,000-1,50,000, about 10% of them had above Tk. 1,50,000 and the rests (about 38%) had below Tk. 75,000 (Table-1). It indicates that the respondents' economic condition was good.

### Distribution and size of sample homestead forests (HF):

The size of the homestead forests different from household to household. It was within the ranges of 0.03 to 0.4 ha with an average of 0.12 ha. The total surveyed area was 7.05 ha from a total of 60 homesteads. The largest area of homestead forests (1.57 ha) was surveyed in Sholotaka Union and the lowest area (0.67 ha) was surveyed in Bamundi Union among the six Unions. The average area of homestead forests per Union was 1.17 ha (Table-2). The size of the homestead forests area was considered into three categories<sup>37</sup>. These were small size (up to 0.05 ha), medium size (above 0.05 ha to 0.25 ha) and large size (more than 0.25 ha) of homesteads. In the study area, about 60% of the total homesteads were medium size, 30% small and only 10% large size. The homestead was counted to determine the farm size through only land surrounding i.e. house, yard (back and front) and pond were included for the categories of

homestead size. The percentage of the homestead forests on the basis of the size of the area has been shown in the Figure-2.

It was found that some other studies have the size of the homestead forests was varied from 0.043 ha to 0.435 ha, 0.05 ha to 0.41 ha, 0.02 to 0.48 ha and 0.05 to 0.25 ha in Chittagong, Thakurgaon and Northern part of Bangladesh<sup>37,40-42</sup>. The average size of the homesteads in the study area was higher than

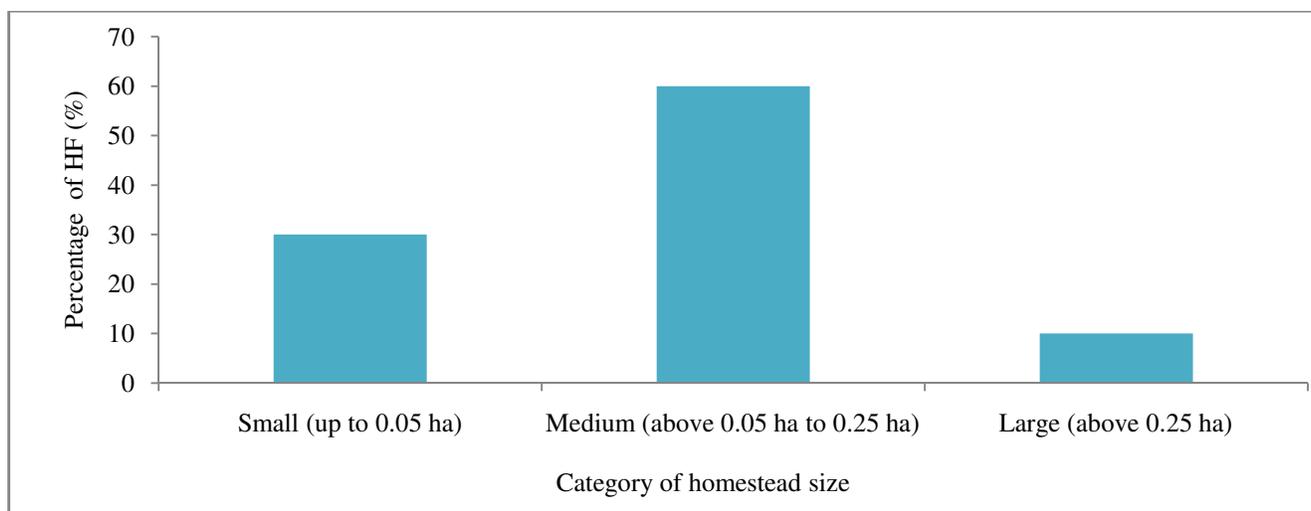
those found by some other studies in Southwest Bangladesh (average of 0.10 ha), Dinajpur district (0.06 ha) and Southwestern Bangladesh (0.11 ha)<sup>43,44,27</sup>. On the other hand, the average size of the homestead in the study area was also smaller than those found in other areas of Bangladesh showed in Sandwip Upazila (0.206 ha), in Fatickchari Upazila (0.19 ha) of Chittagong district respectively<sup>45-46</sup>.

**Table-1:** Demographic and socio-economic status of the respondents.

Age Distribution		Educational status		Household size	
Categories	%	Categories	%	Categories	%
Young Aged (up to 35)	18.33	Primary	43.33	Small (up to 4 members)	26.67
Middle Aged (36-50)	56.67	Secondary	33.33	Medium (5-8 members)	58.33
Old Aged (Above 50)	25.00	Higher Secondary	6.67	Large (above 8 members)	15
		Graduate	8.33	Average household size- 5.8	
		Illiterate	8.33		
Main Occupation of the Respondent			Annual Income of the Respondent		
Categories	%	Categories	%	Categories	%
Agriculture	63.33			Below Tk. 75000	38.33
Business	16.67			Tk. 75000-150000	51.67
Service	10.00			Tk. Above 150000	10.00
Others	10.00				

**Table-2:** Number and area of the homestead forests.

Union	HF No.	Total HF area (ha)	Average HF area/HH (ha)
Bamundi	10	0.67	0.07
Shaharbati	10	1.23	0.12
Raypur	10	1.08	0.11
Sholotaka	10	1.57	0.16
Tetulbaria	10	1.46	0.15
Dhankhola	10	1.03	0.10
Mean	10	1.17	0.12
Total	60	7.05	



**Figure-2:** Size of homestead forests (HF) according to categories of size.

**Structure of homestead forests:** 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<sup>47,48, 27</sup>.

**Horizontal structure of homestead forests:** From the surveyed area, out of all species most of the respondents planted in both the border and interior parts of their homesteads. These were included many medium and small crown timber and fruit species; i.e. Mango, Jackfruit, Betel nut, Ata, Neem etc. About 68.33% homesteads planted species both in the border and interior parts, 20% species planted border only i.e. Coconut, Betel nut, Mehagoni, Sissoo, Jam etc. and only 11.67% interior part only. Lemons, Papaya, Guava, and Boro were planted in the interior part of the homestead forests (Table-3). The most frequently plants were usually grown in the back yard, at the pond dike and around the house. Fruit species were the dominant part of the homestead forest near the living quarters. Most of the respondents planted plant species in both the border and interior parts of their homesteads but it was found that some other studies were showed in Sandwip Upazila, and Fatickchari Upazila of Chittagong only interior part in their studies respectively<sup>49-50</sup>.

The total of 4168 tree and shrub individuals were found and recorded from the study area. Each homestead forest contained the average of 70 individual trees and shrubs species which represented by 61 trees and 9 shrubs. Among the total number of individual trees and shrubs were 87.72% trees and the rest (12.28%) shrub species (Table-4). Every individual of trees and shrubs were counted. In case of herbs only species were recorded. It is found that some other studies have similar types of homestead forest species in southwestern part of Bangladesh reported that the percentages individual of trees are lower and shrubs are higher by Kabir and Webb in Southwest Bangladesh (93% were trees and only 7% shrub individuals)<sup>27</sup>.

**Table-3:** Plant species location in homestead forests.

Category of the species location	No. of HF	Percentage (%)
Species in border only	12	20
Species in interior only	7	11.67
Species in both border and interior	41	68.33
Total	60	100.00

**Table-4:** Number, average and percentage of individual trees and shrubs in the study area.

Form	Total no. of individual	Average no. of individual	% of individuals
Tree	3656	60.93	87.72
Shrub	512	8.53	12.28
Total	4168	69.47	100

**Vertical structure of HF:** The homestead forests in the study area demonstrated complex structure with a usually multilayered canopy configuration. There were convenient and relatively feasible to distinguished four vertical strata. Canopy was stratified into four strata on the basis of specific height classes. The study revealed that the *top layer or over-storey* (above 15m) consisted of different mature and dominant fruit and timber trees such as Coconut, Mehagoni, Sissoo, Koroi, Betel nut, Date palm, Palmyra palm, Neem, Blackberry, Bamboo etc. Some sapling of fruit trees and timber species such as Mango, Jackfruit, Lemons, Indian plum, Wood apple, Bullock’s heart, Kat badam etc. occupied *middle canopy* from above 5m to 15m. *Under-storey* (above 2m to 5m) consisted of Guava, Banana, Golden apple, Lemon, Litchi, Papaya,

Pomegranate and some flowering species. A mixture of shrubs and climbers were predominated in the under storey. The ground layer (up to 2m) most of the species were herbaceous perennial plants, vegetables and medicinal plants like lady’s finger, Elephant foot aroid, Eggplant, Ginger, Turmeric etc. (Table-5). This stratum receives little direct sunlight than other strata. The result was shown that the homestead forests with many life forms were varying from ground to top strata and also created the forest like multistoried canopy structure of homestead forests. The vertical structure of homestead forests was similar to the other studies were reported from different regions of Bangladesh<sup>51,52</sup>. This study was carried out to simplify the organization of complex vegetation types on the basis of specific height classes.

**Plant species composition:** The total number of 73 plant species under 39 families was recorded from the selected 60 homestead forests (Table-7). Among the recorded species, 42 (57.53%) were trees which followed by 13 (17.81%) shrubs and 18 (24.66%) herbs. Trees and herbs species were predominated in the study area, accounting about 82% of the total recorded species (Table-6). About 93% (68) of all species were planted by the farmers and among all species 52% (38) of species were native based on Indian sub-continent (Table-6). Most of the respondents preferred fruit trees and vegetables for their subsistence consumption and family income in the study area.

The study revealed that the numbers of plants species were higher than those found in other homestead in different areas of

Bangladesh. It was found 62 species in Kishoreganj Sadar Upazila, 60 species in Sylhet Sadar Upazila, 58 species in Southwest region of Bangladesh, 52 species in Tangail district, 34 species in Ishurdi, Pabna, 28 species in Jessore district, 20 species in Patuakhali district, 28 species in Rajshahi district and 21 species in Rangpur district respectively<sup>53-56</sup>. The existing plant species composition in the study area was lower than those found in other areas of Bangladesh. A total of 419 plant species found from southwestern Bangladesh, 142 species and 101 species were recorded in an offshore island (Sandwip Island) in Chittagong district from two different studies<sup>27, 57-58</sup>. Total 92 perennial plant species were identified and recorded in one of the study which was conducted in different parts of the country<sup>59</sup>.

**Family wise species diversity:** A total of 73 plant species and 39 families were recorded from the selected 60 homestead forests (Table-7). It was found that the Leguminosae family held the top rank of the lists and was represented by 7 species. Palmae (4 spp.) and Rutaceae (4 spp.) were the major families available in the sample homesteads. Amaranthaceae, Araceae, Combretaceae, Compositae, Moraceae, Myrtaceae and Oleaceae families were represented by three species. Anacardiaceae, Annonaceae, Malvaceae, Meliaceae, Rosaceae, Rubiaceae, Rubiaceae, Rubiaceae, Solanaceae and Verbenaceae families focused two species and the rest of the families represented single species separately (Table-7).

**Table-5:** Vertical structure of homestead forests.

Stratum	Height	Types of the species	Name of the species
Ground	Up to 2m	Vegetables, medicinal, tubers etc.	Giant taro, Lady’s finger, Elephant foot aroid, Eggplant, Turmeric etc.
Under-storey	Above 2m to 5m	Food plants, saplings of fruits, some shrubs	Guava, Papaya, Banana, Lemons, Indian plum etc.
Middle canopy	Above 5m to 15m	Fruit/timber trees	Mango, Jackfruit, Wood apple, Bullock’s heart etc.
Top/Over-storey	Above 15m	Fruit and timber trees	Coconut, Betel nut, Palmyra palm, Date palm, Mehagoni, Neem, Blackberry etc.

**Table-6:** Plant species composition in the sample homestead forests.

Species		Domesticity		Origin	
Form	Number	Planted	Natural	Native	Exotic
Tree	42 (57.53%)	40 (95.24%)	2 (4.76%)	25 (59.52%)	17 (40.48%)
Shrub	13 (17.81%)	12 (92.31%)	1 (7.69%)	3 (23.08%)	10 (76.92%)
Herb	18 (24.66%)	16 (88.89%)	2 (11.11%)	10 (55.56%)	8 (44.44%)
Total	73	68 (93%)	5 (7%)	38 (52%)	35 (48%)

**Table-7:** Number of families with the number of plant species in the study area.

S/N	Family Name	Species No.
1	Leguminosae	7
2	Palmae	4
3	Rutaceae	4
4	Amaranthaceae	3
5	Araceae	3
6	Combretaceae	3
7	Compositae	3
8	Moraceae	3
9	Myrtaceae	3
10	Oleaceae	3
11	Anacardiaceae	2
12	Annonaceae	2
13	Malvaceae	2
14	Meliaceae	2
15	Rosaceae	2
16	Rubiaceae	2
17	Solanaceae	2
18	Verbenaceae	2
19	Agavaceae	1
20	Bombacaceae	1
S/N	Family Name	Species No.
21	Cactaceae	1
22	Caricaceae	1
23	Ebenaceae	1
24	Euphorbiaceae	1
25	Gramineae	1
26	Lauraceae	1
27	Liliaceae	1
28	Lythraceae	1
29	Moringaceae	1
30	Musaceae	1
31	Nyctaginaceae	1
32	Oxalidaceae	1
33	Punicaceae	1
34	Rhamnaceae	1
35	Sapindaceae	1
36	Sapotaceae	1
37	Sterculiaceae	1
38	Ulmaceae	1
39	Zingiberaceae	1

Total no. of family was 39 and total no. of species was 73.

**Types of plant species and family wise species composition in the sample homestead forests: Types of plant species:**

A total of 73 plant species recorded in the study area where the highest number of plant species (47) was found in the large size of homestead and the lowest number of species (28) found in the small homestead (Figure-3). Mango, Coconut, Mehagoni, Neem, Blackberry, Guava, Lemons, Papaya, Banana were found common in most homesteads.

Comparison to the other study that the highest and lowest number of plant species was found in the homesteads of the study area, which had shown lower than those were found in the other studies in terms of number of plant species. The other study results showed that 71 plant species found in small, 98 in medium and 108 in large size of homestead in an offshore island (Sandwip Island) in Chittagong district respectively<sup>60</sup>.

**Family wise species composition:** Among 39 families, 21 (54%) families of plant species, each family represented one species, 8 (20%) families represented two species, 7(18%) families represented three species, 2 (5%) families represented four species and 1 (3%) family represented seven species in the study area (Table-7).

We found other two studies that had been documented total number of family (61 and 36 respectively) of plant species. One was greater and another was less than this study<sup>61-62</sup>.

**Table-8:** Family wise species composition.

No. of Species	No. of Represented Families
1x21 species	21 (54%)
2x8 species	8 (20%)
3x7 species	7 (18%)
4x2 species	2 (5%)
7x1 species	1 (3%)
Total 73 species	Total 39 families

**Species frequency of homestead forests:** Among the 73 plant species, the ranges between 6-10 species were found in 3.33% homesteads, 11-15 species were 8.33% homesteads, 16-20 species were 26.67% homesteads, 21-25 species were 33.33% homesteads, 26-30 species were 13.33% homesteads and more than 35 species were found in only 8.33% homestead forests in the study area (Figure- 4).

So, most of the homestead forests about 60% contained the number of species ranges between 16-30 species.

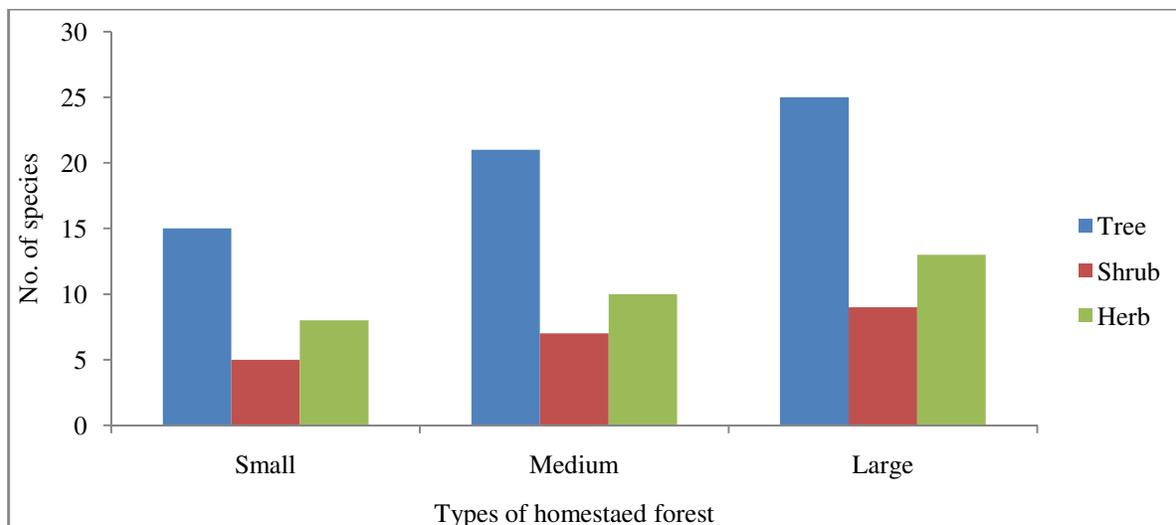


Figure-3: Types of plant species according to size of homestead forest.

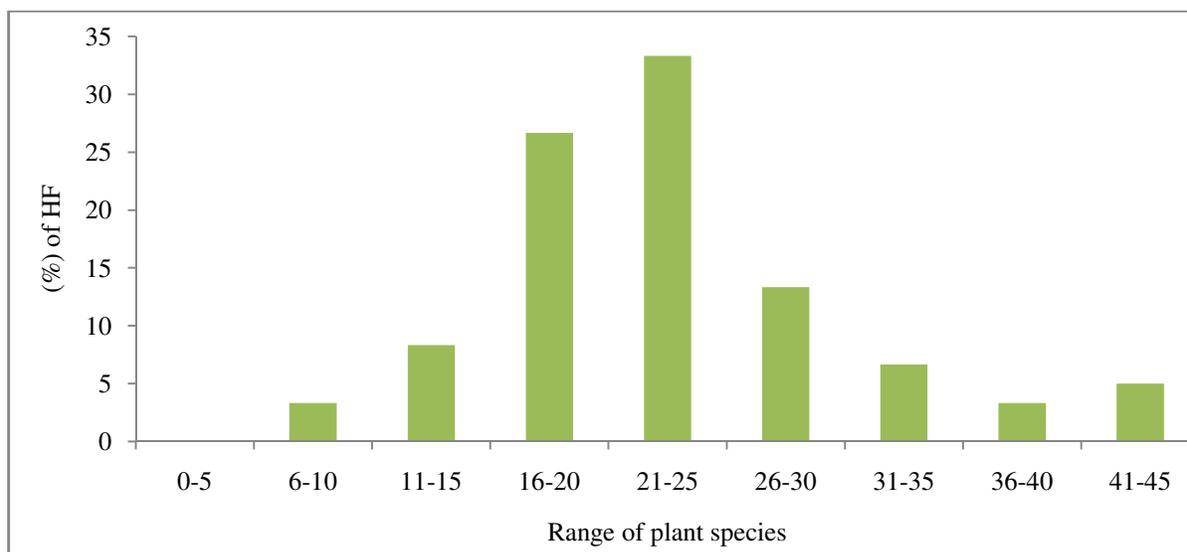


Figure-4: Frequency distribution of species in the homestead forests.

**Frequency and relative frequency of plants species in the homestead forests:** The importance value of different plant species had showed on the basis of their respective frequency and relative frequency in the study area (Table-9). The study revealed that among tree species of Am (*Mangifera indica*), Narikel (*Cocos nucifera*), Neem (*Azadirachta indica*), Batabi lebu (*Citrus grandis*) and Peara (*Psidium guajava*) were frequently distributed species with relative frequencies of 6.41%, 6.03%, 5.78%, 5.65 and 5.15 respectively and Kanthal (*Artocarpus heterophyllus*), Mehagoni (*Swietenia macrophylla*), Jam (*Syzygium cumini*), and Kul (*Ziziphus nummularia*) were dominant species than other trees with the absolute frequencies of 39, 39, 36 and 34 respectively (Table-9). Am (*Mangifera indica*), Narikel (*Cocos nucifera*) were the most important fruit species in the study area. In terms of shrubs, Kagogee lebu (*Citrus limon*) and Mendi (*Lawsonia inermis*) were the most important species with their frequencies of 38 and 28

respectively. Among the herb species, Mankachu (*Alocasia indica*) and Pape (*Carica papaya*) were the most important species with their frequencies of 44 and 39 respectively in the study area (Table-9).

Five most important species of trees such as Am (*Mangifera indica*), Narikel (*Cocos nucifera*), Neem (*Azadirachta indica*), Batabi lebu (*Citrus grandis*) and Peara (*Psidium guajava*) were shown relatively similar relative frequency among the other species. Among the five most important shrubs, Lemon (*Citrus limon*) was substantially higher frequency than other four species in the selected homesteads. In terms of herb, *Alocasia indica* and *Carica papaya* were highly frequent out of the five most important herbs in homestead forests. Therefore, *Citrus limon* and *Alocasia indica* were mostly dominated shrub and herb species respectively in the study area (Table-9).

**Table-9:** Frequency (F) and Relative Frequency (RF) of plant species found in the study area.

Tree Species				
Common/Local Name	Scientific Name	No. of Homestead	Frequency (%)	Relative Frequency (%)
Babla	<i>Acacia nilotica</i> Karst.	4	6.67	0.50
Bel	<i>Aegle marmelos</i> (L.) Correa	31	51.67	3.89
Kala Koroy	<i>Albizia lebbeck</i> (L.) Benth.	5	8.33	0.63
Sada koroy	<i>Albizia procera</i> (Roxb.) Benth.	4	6.67	0.50
Ata	<i>Annona reticulata</i> L.	33	55.00	4.15
Kadam	<i>Anthocephalus chinensis</i> (Lmk.) A. Rich. ExWalp.	15	25.00	1.88
Supari	<i>Areca catechu</i> L.	14	23.33	1.76
Kanthal	<i>Artocarpus heterophyllus</i> Lam.	39	65.00	4.90
Kamranga	<i>Averrhoa carambola</i> L.	12	20.00	1.51
Neem	<i>Azadirachta indica</i> A. Juss.	46	76.67	5.78
Shimul	<i>Bombaxceiba</i> L.	24	40.00	3.02
Tal	<i>Borassus flabellifer</i> L.	22	36.67	2.76
Tejpata	<i>Cinnamomum tamala</i>	1	1.67	0.13
Batabi Lebu/Badam	<i>Citrus grandis</i> (L.) Osbeck	45	75.00	5.65
Narikel	<i>Cocos nucifera</i> L.	48	80.00	6.03
Sissoo	<i>Dalbergia sissoo</i> Roxb.	14	23.33	1.76
Krishnochura	<i>Delonix regia</i> (Boj. ex HK.) Raf.	5	8.33	0.63
Gab	<i>Diospyros peregrina</i> Gurke	3	5.00	0.38
Dumur	<i>Ficus hispida</i> L.f.	27	45.00	3.39
Pakur	<i>Ficus lacor</i> Buch.-Ham.	2	3.33	0.25
Ipil-ipil	<i>Leucaena leucocephala</i> (Lam.) de Wit	21	35.00	2.64
Litchu	<i>Litchi chinensis</i> Sonn.	29	48.33	3.64
Apel	<i>Malus domestica</i>	2	3.33	0.25
Am	<i>Mangifera indica</i> L.	51	85.00	6.41
Bokul	<i>Mimusops elengi</i> L.	9	15.00	1.13
Sajna	<i>Moringa oleifera</i> Lam.	19	31.67	2.39
Sheuli	<i>Nyctanthes arbor-tristis</i>	16	26.67	2.01
Khejur	<i>Phoenix sylvestris</i> Roxb.	27	45.00	3.39
Debdaru	<i>Polyalthia longifolia</i> (Sonn.) Hook. f. and Thomson	6	10.00	0.75
Peara	<i>Psidium guajava</i> L.	41	68.33	5.15
Dalim	<i>Punica granatum</i> L.	15	25.00	1.88
Amra	<i>Spondias pinnata</i> (L.f.) Kurz	24	40.00	3.02
Mehegoni	<i>Swietenia macrophylla</i> King	39	65.00	4.90
Jam	<i>Syzygium cumini</i> (L.) Skeels	36	60.00	4.52
Jamrul	<i>Syzygium samarangense</i> (Blume) Merr. and L.M. Perry	4	6.67	0.50
Tentul	<i>Tamarindus indica</i> L.	6	10.00	0.75
Segun	<i>Tectona grandis</i> L.f.	6	10.00	0.75

Arjun	<i>Terminalia arjuna</i> Wight and Arn.	2	3.33	0.25
Katbadam	<i>Terminalia catappa</i> L.	5	8.33	0.63
Horitoki	<i>Terminalia chebula</i> Retz.	2	3.33	0.25
Jibon	<i>Trema orientalis</i> (L.) Blume	8	13.33	1.01
Boroi/Kul	<i>Ziziphus nummularia</i> (Burm.f.) W. and A.	34	56.67	4.27
Shrub Species				
Ulotkambal	<i>Ambroma augusta</i> (L.) L.f.	13	21.67	6.16
Hasnahena	<i>Cestrum nocturnum</i> L.	5	8.33	2.37
Kagojee Lebu	<i>Citrus limon</i> (L.) Burm.f.	38	63.33	18.01
Patabahar	<i>Codiaeum variegatum</i> (L.) Blume	21	35.00	9.95
Gongharaj	<i>Gardenia jasminoides</i> Ellis	10	16.67	4.74
Joba	<i>Hibiscus rosa-sinensis</i> L.	16	26.67	7.58
Jui	<i>Jasminum auriculatum</i> Vahl	5	8.33	2.37
Beli	<i>Jasminum sambac</i> (L.) W.A.T.	7	11.67	3.32
Kutuskata/Putuskata	<i>Lantana camara</i> L.	27	45.00	12.80
Mendi	<i>Lawsonia inermis</i> L.	28	46.67	13.27
Kamini	<i>Murraya paniculata</i> (L.) Jack	11	18.33	5.21
Golap	<i>Rosa damascena</i> Mill.	15	25.00	7.11
Begun	<i>Solanum melongena</i> L.	15	25.00	7.11
Herb Species				
Deros/ Vendi	<i>Abelmoschus esculentus</i> (L.) Moench.	13	21.67	3.50
Man Kachu	<i>Alocasia indica</i> (Lour) Koch	44	73.33	11.86
Ghrita Kumari	<i>Aloe indica</i> Royle	5	8.33	1.35
Lal Shak	<i>Amaranthus gangeticus</i> L.	19	31.67	5.12
Data Shak	<i>Amaranthus oleraceus</i> L.	23	38.33	6.20
Ol Kachu	<i>Amorphophallus paeoniifolius</i> (Denn.) Nicol.	25	41.67	6.74
Bansh	<i>Bambusa spp.</i>	31	51.67	8.36
Pape	<i>Carica papaya</i> L.	39	65.00	10.51
Morogfull	<i>Celosia argentea</i> L.	12	20.00	3.23
Kachu	<i>Colocasia esculenta</i> (L.) Schott	31	51.67	8.36
Holud	<i>Curcuma longa</i> L.	32	53.33	8.63
Dalia	<i>Dahlia rosea</i> Cav.	8	13.33	2.16
Tarulata	<i>Mikania cordata</i>	3	5.00	0.81
Shondhamaloti	<i>Mirabilis jalapa</i> L.	18	30.00	4.85
Kola	<i>Musa acuminata</i>	30	50.00	8.09
Fonimonsa	<i>Opuntia dillenii</i> Haw.	14	23.33	3.77
Rajanigondha	<i>Polianthes tuberosa</i> L.	11	18.33	2.96
Gada	<i>Tagetes patula</i> L.	13	21.67	3.50

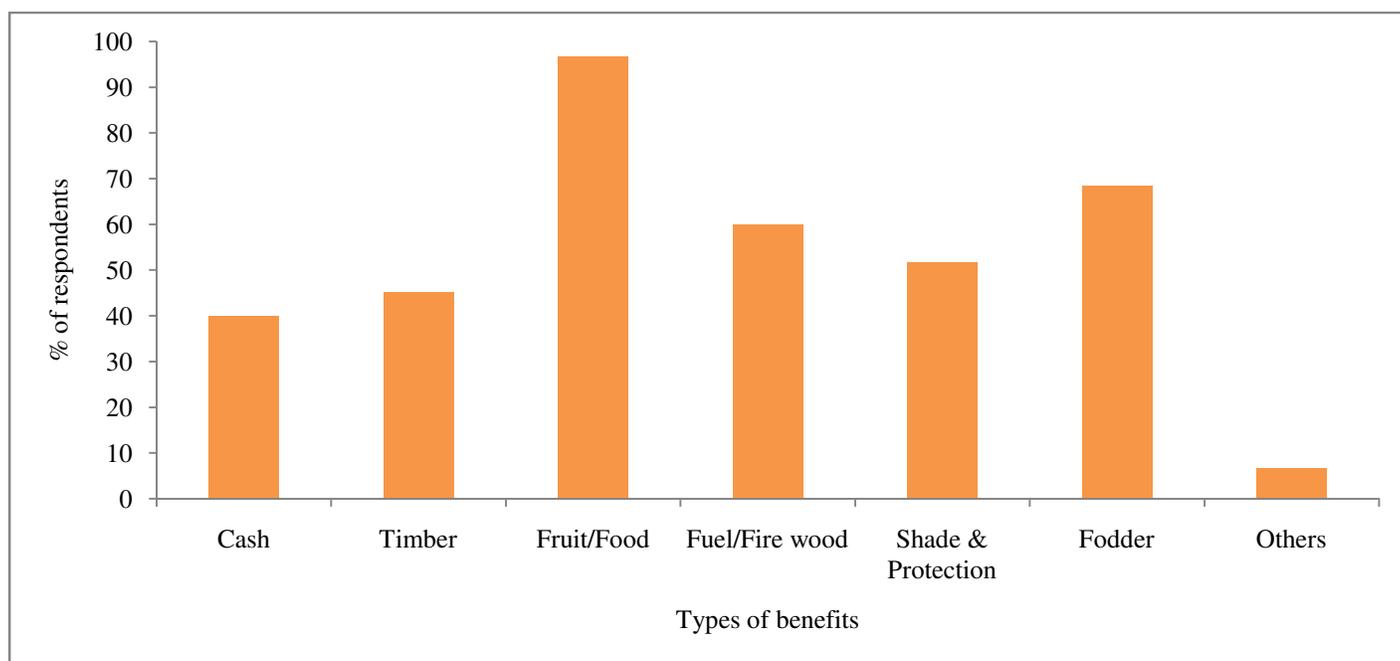
**Utilization of homestead forests:** In the study area, the most important plant species of homestead forest were denoted and recorded in each life form according to their uses and relative frequencies.

**Types of benefits derived from homestead forests:** Most of the respondents benefited from trees on their homestead forests. They said that homestead forests act as a reserve bank for future generation of the respondent. They got fruits/food, timber, cash to fulfill their own needs, fuel wood, fodder for their livestock and fencing and construction materials, while other respondents got shelter or shade requirements for their living house and livestock from homestead forests. From Figure-4.6 shows that most of the farmers 96% got food/fruits from trees for consumption. About 68% got fodder, 60% got fuel wood, 51% got shelter and shade, 45% got timber, 40% got cash return from tree. Only 7% farmers said, they got seeds, seedlings, construction and fencing materials etc. (Figure-5). These percentages can be overlapping because of respondents had multiple response.

Bangladesh largely depend on homestead forests for their needs and own consumption. The owners of the homestead forest preferred fruit and timber species for making a future asset as well as food security. Major utilizations of tree based products were the following:

**Fruit:** Food preference of the respondent is depended on their income level. It was observed that food/fruit species were the dominant in the study area and were almost common in every homestead forest. About 96% respondents said that they got benefit of food/fruits from their homestead forests. Generally, primary and secondary uses were found from fruit/food tree species. Uses of five most usable food species found in the study area which had been shown in the Table-10.

**Major utilizations of tree based products from homestead forests:** Majority of the people of Southwestern part of



**Figure-5:** The percentage of respondents according to benefits derived from homestead forests.

**Table-10:** Primary and secondary uses of five important fruit species.

Local Name	Scientific Name	Primary uses	Secondary uses
Am	<i>Mangifera indica</i> L.	Fruit/Food	Furniture, Fodder, Construction
Narikel	<i>Cocos nucifera</i> L.	Fruit/Food	Fuel wood, Construction
Batabi Lebu	<i>Citrus grandis</i> (L.)	Fruit/Food	Medicine, Fuel wood
Peara	<i>Psidium guajava</i> L.	Fruit/Food	Fuel wood, Fodder
Kanthal	<i>Artocarpus heterophyllus</i>	Fruit/Food	Furniture, Fodder, Construction

**Timber:** People of the study area selected timber species for furniture making and future investment. Among the Respondents, 45% fill up their timber demand from their homestead forest. For these purpose, they planted different types of timber producing species in their homesteads. They also generated cash by selling extra timber in the market. Uses of five most valuable timber species were identified and recorded in the study area which had been shown in the Table-11.

**Table-11:** Primary and secondary uses of five important timber species.

Local Name	Scientific Name	Primary uses	Secondary uses
Mahegoni	<i>Swietenia macrophylla</i> King	Timber	Furniture, Construction
Neem	<i>Azadirachta indica</i> A. Juss.	Timber	Medicine, Construction
Kanthal	<i>Artocarpus heterophyllus</i>	Timber	Furniture, Construction
Jam	<i>Syzygium cumini</i> (L.)	Timber	Furniture, Construction
Kadam	<i>Anthocephalus chinensis</i>	Timber	Furniture, Boxes

**Fuel and Fire Wood:** Generally, the people did not planting any species only for the purpose of using it as fuel. Most of the fuelwood species are used as other purpose with fuel. About (60%) respondents said that when they collected fuel from their homestead forests. Sometimes they used fallen dry leaves for fuel and also sold the extra fuel wood and leaves for cash generation. Ipil-ipil (*Leucaena leucacehala*), Kadam (*Anthocephalus chinensis*), Sissoo (*Dalbergia sissoo*), Mehagoni (*Swietenia macrophylla*) were the most usable fuel wood species in the study area.

**Fodder:** Several tree species having palatable and nutritious fodder were used as fodder bank during scarcity periods. Several species such as Kanthal (*Artocarpus heterophyllus*), Ipil-ipil (*Leucaena leucacehala*), Am (*Mangifera indica*), Pears (*Psidium guajava*) etc. were provided better quality of fodder. Among the respondents about 68% said, they got fodder from homestead forests. The respondents met up their fodder demand by planting different fodder species in their homesteads. They got some others benefits from homestead forests such as pole, fencing and construction materials etc.

**Cash generation:** Most of the respondents (40%) of the study area increased their income through generating cash from the homestead forest. They spent cash for buying food, for housing, children education, medical cost and others purposes. Cash was generally earned by selling timber, fruit, fuel wood, vegetables etc.

**Respondent attitudes towards homestead forest:** The results revealed that majority of the farmers had favorable attitudes towards homestead forest in the study area. Among them about

70% were shown favourable attitude for meeting their necessary of diversified forest products, about 17% respondents were shown not favourable because they thought that sometimes tall and disperse fruit and timber trees also created problem with neighbours and prevents direct sunlight to the undergrowth and hampering to the production of vegetables and only about 13% were confused (Table-12).

**Table-12:** Respondents' attitudes towards homestead forest.

Categories	No. of Respondents (%)
Favourable	42 (70%)
Not favourable	10 (16.67%)
Confused	8 (13.33%)
Total	60

**Problems and constraints of tree growing in the homesteads:**

The respondents of the study area were faced various types of problem during practice of homestead forests. Various constraints like physical, technical and socioeconomic were identified in case of tree growing in the homestead by the farmers. The most common constraint of tree growing in homestead was lack of technical knowledge which was reported by 65% of the respondent. Unavailability of good and quality seed/seedlings (58%) and problems of livestock rearing (55%) were reported to be the other constraints. Other major constraints of planting new trees on households were prevents sunlight and air (32%), Unavailability of space (30%), conflicts with neighbours (25%), other problems (20%) (Table-13).

**Table-13:** Problems and constraints of planting trees in the homesteads.

Constraints	No. respondents and (%)
Unavailability of good and quality seed/seedlings	35 (58.33%)
Deficiency of technical knowledge	39 (65%)
Unavailability of space utilization	18 (30%)
Problem of livestock	33 (55%)
Prevents sunlight and air	19 (31.67%)
Conflicts with neighbours	15 (25%)
Others	12 (20%)

**Conclusion**

Now-a-days population is increasing at an alarming rate in our country. With the increasing population pressure, the forest and forest related resources are depleting at a danger rate. The existing forest cannot meet the demand for the nation. More tree

species planting in homestead forest can be desirable for the aesthetic, environmental and economic perspectives. It can create job and income opportunities for rural people. It can also involve the rural people to increase their family income for better livelihood. The various types of plant species in homestead can play a vital role in enhancing the resource diversity and providing agriculture and forest products in the study area. Homestead forests can emerge as an effective mean for both economic and environmental well-being. Therefore, the government should try to help the farmers by providing trainings, seedlings, technical and financial support which encourages the farmers to grow more plant species in their homesteads.

From the observations of the field survey and on the basis of the synthesized results some recommendations can be followed for improving the forest cover in the homesteads: i. Unused land is available around most of the households (about 70% respondents said they had available space for planting trees). These lands can be planted with suitable tree species for desired products and services. This will improve food security, nutritional balance, income opportunities and environmental amelioration. ii. The respondents did not follow any planting pattern of plant species in their homesteads. They planted trees wherever the space was available. So training would be beneficial to overcome this situation. iii. With the implications of this study, to find out economic and conservation value of homestead forests, coordinated research by the multidisciplinary scientists would be required in order to better understanding and promoting the practice of homestead forests for the study area. iv. Structure can be improved by better allocation of plants in relation to HF areas. For this further study is necessary on structural improvements.

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